Farmingdale State College

State University of New York

Chemical Hygiene Plan

Last Revised: February 27, 2025

ANNUAL REVIEW

In accordance with OSHA's Occupational Exposure to Hazardous Chemicals in Laboratories standard (29 CFR 1910.1450), referred to as the Laboratory Standard, the employer (Farmingdale State College) must review and evaluate the effectiveness of the Chemical Hygiene Plan (CHP) at least annually and update it as necessary.

Date of Review	Reviewed By	Changes and/or Revisions
02/12/16	Jeff Carter	None
02/10/17	Jeff Carter	None
02/09/18	Jeff Carter	None
02/08/19	Jeff Carter	None
10/31/19	Jeff Carter	Added to section 4.2 (page 10) – "Students shall never be left unsupervised in a laboratory or chemical storage area."
02/18/20	Jeff Carter	None
07/23/21	Jeff Carter	Updated telephone numbers identified within the CHP to reflect change in area code.
02/11/22	Jeff Carter	None
02/13/23	Jeff Carter	Changed CHO reporting structure to reflect Assistant Vice President for Administration & Finance (page 7).
02/28/24	Jeff Carter	None
02/27/25	Jeff Carter	More clearly defined the CHO designation (page 7).
03/04/26	Jeff Carter	None

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Section 1: INTRODUCTION

1.1 Purpose of This Document

This Chemical Hygiene Plan is a document designed to express the policies and procedures adopted by Farmingdale State College (the "College") as they relate to the safe operation of laboratories using chemicals. The Chemical Hygiene Plan is derived from the Laboratory Standard, a regulation promulgated in the January 31, 1990, issue of the Federal Register. The goal of the Laboratory Standard is to provide a safe laboratory workplace, and it includes requirements on occupational exposures to hazardous chemicals.

The Occupational Safety and Health Administration (OSHA) Laboratory Standard requires that employers protect workers through the development and implementation of a Chemical Hygiene Plan tailored to the individual laboratory workplace. The purpose of the Laboratory Standard and of this Chemical Hygiene Plan is to protect employees from harm due to exposure to hazardous chemicals while they are working in the laboratory.

Many policies and practices may not be part of the Chemical Hygiene Plan, and yet they are crucial to the planning process that must be part of maintaining a safe environment for employees and students. It is therefore incumbent upon each employee to maintain a safety conscious approach to their daily work activities, particularly those within a laboratory.

1.2 Application of the OSHA Laboratory Standard

The Occupational Safety and Health Act is administered by the Occupational Safety and Health Administration, which is part of the Department of Labor. OSHA promulgated regulations are found in the Code of Federal Regulations (CFR), Title 29, Section 1910 (cited as 29 CFR 1910). Appendix A of this document contains the full text of 29 CFR 1910.1450, "The Laboratory Standard," and this introduction contains a summary of that code. Farmingdale State College is regulated by the New York State Department of Labor (NYSDOL) and the New York State Division of Safety and Health (NYSDOSH).

What is covered by the Laboratory Standard?

This standard applies to employers engaged in laboratory use of hazardous chemicals.

"Laboratory" means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

"Laboratory use of hazardous chemicals" means handling or use of such chemicals in which all of the following conditions are met:

- Chemical manipulations are carried out on a “laboratory scale” (i.e., work with substances in which the containers used for reactions, transfers, and other handling of substances is designed to be easily handled by one person);
- Multiple chemical procedures or chemicals are used;
- The procedures involved are not part of a production process, nor do they in any way simulate a production process; and
- “Protective laboratory practices and equipment” are available and in common use to minimize the potential for worker exposure to hazardous chemicals.

A “hazardous chemical” is a chemical for which there is statistically significant evidence (based on at least one study conducted according to established scientific principles) that acute or chronic health effects may occur in exposed employees, or if it meets one or more of the following:

- Any chemical which is a physical hazard or a health hazard (OSHA 29 CFR 1910.1200(c)) or 29 CFR 1910.1450(b));
- Any chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, organic peroxide, pyrophoric, unstable (reactive), or reacts violently with water;
- Any chemical, for which there is statistical evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees, is classified as a health hazard. Health hazards include chemicals that are carcinogens, toxin or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems; and agents that damage the lungs, skin, eye or mucous membranes as defined in 29 CFR 1910.1200, Appendix A;
- Any chemical, for which the evaluation performed by the chemical manufacturer/importer, as listed on the Safety Data Sheet (SDS), indicates it is hazardous;
- Any chemical listed in OSHA, 29 CFR 1910 Subpart Z, "Toxic and Hazardous Substances" or Environmental Protection Agency (EPA), 40 CFR Part 261 "Identification and Listing of Hazardous Waste.";
- Any chemical listed in the "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment", American Conference of Governmental Industrial Hygienist (ACGIH) (latest edition) or "The Registry of Toxic Effects of Chemical Substances", NIOSH (latest edition);
- Any chemical regulated by the U.S. Department of Transportation, 49 CFR, Subchapter C, Parts 171-172;
- Any chemical that is capable of causing environmental or health damage if disposed of improperly as specified in the U.S. Environmental Protection Agency, Title 40 Code of Federal Regulations (Resource Conservation and Recovery Act); and
- Any mixture untested as a whole to determine whether it is a physical or health hazard is assumed to present the same physical or health hazard as the individual components that compromise one percent or greater (by weight or volume) of the mixture. An exception is the mixture shall be assumed to present a carcinogenic hazard if it contains a component which is considered to be a carcinogen in concentration of 0.1 percent or greater.

"Employees" who must abide by this Chemical Hygiene Plan are individuals employed in the laboratory workplace who may be exposed to hazardous chemicals in the course of their assignment. Included are employees who work in the laboratory such as instructors and technical support, and other employees of the College who routinely enter the laboratory to perform their assigned responsibilities, such as maintenance and janitorial personnel.

What Is Not Covered by the Laboratory Standard?

Any hazardous chemical use which does not meet this definition is regulated under other standards. This includes other hazardous chemical use within a laboratory. For instance:

- Chemicals used in building maintenance of a laboratory are not covered under the Laboratory Standard.
- The production of a chemical for commercial sale, even in small quantities, is not covered by the Laboratory Standard.
- Quality control testing of a product is not covered under the Laboratory Standard.

The laboratory Standard is a regulation promulgated for the protection of employees. **Since students are not employees, they are not officially covered by provisions of the Chemical Hygiene Plan. However, since this document contains guidance on generally accepted good laboratory practice, it should be used to establish minimal safety instruction and procedures for students.**

Additionally, laboratory visitors, such as sales staff, outside repair persons, and guests are not included in the definition of employee and thus do not need to be addressed in the Chemical Hygiene Plan.

1.3 Summary of the Chemical Hygiene Plan

In compliance with the Laboratory Standard, the College has prepared and implemented this Chemical Hygiene Plan (the "Plan"). Adherence to the Plan will assure that employees will be protected from health hazards associated with hazardous chemicals in the laboratory, and exposed to regulated substances at a level that will not exceed the permissible exposure limits.

This Chemical Hygiene Plan is composed of the following sections:

- This introduction which states the goal and basis for the Chemical Hygiene Plan.
- A list of the College personnel responsible for various aspects of the Plan and its implementation.
- General principles which outlines the guidelines for working with laboratory chemicals.
- Standard operating procedures for laboratories, the implementation of which will help the Chemical Hygiene Officer and all employees in meeting the goal of the Chemical Hygiene Plan.
- Record-keeping requirements and procedures for reporting items related to laboratory health and safety.

- Laboratory safety procedures.
- Procedures for inspecting laboratories and reviewing the Chemical Hygiene Plan.
- A description of the situations in which employees must use specific exposure control measures.
- Information regarding training opportunities for employees.
- Emergency response procedures.
- Spill response procedures.
- Appendices which supply references and other useful information.

Section 2: COLLEGE ORGANIZATION

The continuing execution of the provisions of the **College's** Chemical Hygiene Plan is a responsibility of all employees who are involved in the laboratory science program. However, certain employees and entities are specifically charged with the successful execution of the Chemical Hygiene Plan.

2.1 President or Chief Executive Officer

The **President**, as Chief Executive Officer, has the ultimate responsibility for chemical hygiene within the **College**. The **President** should, with other administrators, provide continuing support for **College**-wide chemical hygiene programs, including the development and enforcement of the Chemical Hygiene Plan.

2.2 Dean

In each school, the **Dean** or other administrative head is responsible for chemical hygiene programs at that location. The **Dean** should monitor compliance with the Chemical Hygiene Plan.

2.3 Project Director

Some situations may require a Project Director, who may be a department head, professor, or someone from outside the normal school structure who has a particular responsibility related to the laboratory, but who is not part of the regular teaching or instructional responsibilities. The project director has specific responsibilities requiring work in the laboratory, **which is not done as part of a regular class**. The project director has the primary responsibility for chemical hygiene procedures for that project.

2.4 College

The responsibilities of the **College**, which is the employer of record, include the following:

- Appointing a Chemical Hygiene Officer and assigning the Chemical Hygiene Officer the various responsibilities outlined below:

    - ✓ Making manufacturer's safety data sheets (SDS's) accessible to employees.
    - ✓ Providing employees with training and information regarding chemical and physical hazards.
    - ✓ Posting "Designated Areas" if any select carcinogens, reproductive toxins, or acute toxins are used in the laboratory.
    - ✓ Measuring the concentration of hazardous chemical(s), if there is any reason to believe that the action level has been exceeded.

- ✓ Keeping records of employee exposure to hazardous chemicals for a period of 30 years beyond the time of exposure. These records should be filed by the employee, with the College, in writing, within two weeks of the exposure.
- ✓ Facilitating medical consultations and examinations required as a result of exposure to hazardous chemical(s).
- ✓ Ensuring a Respiratory Protection program is in place and that employees are provided respirators when necessary.

2.5 School Employees

All employees who normally work in a laboratory area are responsible for:

- Participating in training programs provided by the **College**.
- Maintaining awareness of health and safety hazards.
- Planning and conducting each operation in accordance with the **College's** chemical hygiene procedures.
- Consulting reference materials, including safety data sheets, related to chemical safety whenever appropriate.
- Using good personal chemical hygiene habits.
- Reporting accidents, injuries, unsafe practices, and unsafe conditions.

2.6 Chemical Hygiene Personnel

The Farmingdale State College Environmental Health & Safety (EH&S) Officer is appointed by the President. The EH&S Officer will serve as the Chemical Hygiene Officer (CHO) for the College unless otherwise designated, in which case this Plan will reflect such change.

The Chemical Hygiene Officer will report to the Assistant Vice President for Administration & Finance or her designee.

The responsibilities of this position require the Chemical Hygiene Officer to:

- Develop and implement the Chemical Hygiene Plan and the safety program for the College, including training, reporting, and other functions noted here.
- Work with administrators and teachers to develop and implement the safety program.
- Monitor the use and disposal of chemicals used in the schools' laboratory programs.
- Assure that inspections of equipment and space in the laboratory are performed when appropriate and that records of inspections are maintained.
- Provide technical assistance to employees on the Chemical Hygiene Plan.
- Assure that the Chemical Hygiene Plan is reviewed annually and revised as needed, so that it is always in compliance with current legal requirements.
- Make decisions regarding requests to use chemicals identified as explosive, carcinogenic, mutagenic, highly toxic, or otherwise unsuitable for general school laboratories.
- Determine the need for personal protective equipment beyond that specified for general laboratory use.

- Implement appropriate training with regard to chemical hygiene for all employees whose normal work locations include laboratory areas.

2.7 Students

Students are not specifically covered by the Laboratory Standard. However, good personal chemical hygiene habits should be taught to all students at every reasonable opportunity, particularly to those who use the laboratory while enrolled in science courses. Students are not allowed to use school laboratories outside of regular science course classes unless they first obtain permission and are directly supervised by the instructor during their work.

Section 3: GENERAL PRINCIPLES

The following statements and explanations are general principles for the use of those handling laboratory chemicals. While the list is not complete, these concepts provide the fundamental underpinning for laboratory work at this College.

3.1 Be Prepared

The College will train employees in how to find and use information from SDSs, this Chemical Hygiene Plan, and other safety publications. Employees should familiarize themselves with the hazards associated with the chemicals they expect to use and should take appropriate steps to minimize their exposure to those chemicals.

3.2 Follow the Chemical Hygiene Plan

The Chemical Hygiene Plan provides specific laboratory practices designed to minimize employees' exposure to hazardous substances. Employees should follow the practices specified in the Chemical Hygiene Plan to minimize their health and safety risks.

3.3 Minimize Exposure to Chemicals

It is prudent to minimize all chemical exposures, because most laboratory chemicals present hazards of one type or another. Employees will follow general precautions for handling all laboratory chemicals. Specific guidelines for some chemicals, such as those found in the appropriate SDSs, will also be followed.

3.4 Consider the Risk

Employees should not underestimate risk, and exposure to hazardous substances should be minimized. The decision to use a particular substance will be based on the best available knowledge of each chemical's particular hazard and the availability of proper handling facilities and equipment. Substitutions, either of chemicals or experiments, will be made where appropriate to reduce hazards without sacrificing instructional objectives. When the risk outweighs the benefit and no substitute is available, then the experiment, procedure, or chemical

should be eliminated. The Chemical Hygiene Officer should be consulted before final determinations and decisions are made in this regard.

3.5 Observe PELs and TLVs

The permissible exposure limit (PEL) and threshold limit value (TLV) of a typical chemical used in the laboratory are available on the SDS for that chemical. Employee exposure to hazardous chemicals should not exceed those limits.

3.6 Provide Adequate Ventilation

The best way to prevent exposure to airborne substances is to prevent their escape into the laboratory by using hoods or other ventilation devices. Those devices should be kept in good working condition in order to provide employees with a safe working area. The later section on inspections in the laboratory (Section 7) establishes procedures for ensuring that equipment is working properly.

3.7 Use Safety Data Sheets

The College should not accept a chemical from a supplier unless it is accompanied by the corresponding SDS, or an SDS from that supplier for that chemical is already on file. All SDSs should be accessible to employees at all times. Employees should be trained to read and use the information found on SDSs.

Section 4: STANDARD OPERATING PROCEDURES

The goal of the Chemical Hygiene Plan is to protect employees who work in the laboratory, others who may be exposed, and the environment from hazardous chemicals. This section is written in several parts and is meant as a guide for the College and its employees. Other specific safety rules for a particular laboratory may be added by the Chemical Hygiene Officer, as needed.

It is recommended that these same standards be communicated to students, expected of students, and promoted by the school and laboratory personnel.

4.1 General Rules

The instructor (and technical support staff, if any) should review laboratory instructions, safety procedures, and reagents prior to each laboratory activity. They should be aware of the following:

- The chemical hazards for each chemical, as determined from the SDS or other appropriate reference.
- Appropriate safeguards for using each chemical, including personal protective equipment.
- Location and proper use of emergency equipment.
- Proper storage of chemicals.

- Appropriate personal hygiene practices.
- Correct methods for transporting chemicals within the laboratory facility.
- Appropriate procedures for emergencies, including evacuation routes, spill cleanup procedures, and fire control.
- Proper procedures for the disposal of hazardous substances.
- Procedures for notifying supervisory persons in the case of an accident or injury.

4.2 Working Alone

Employees should not work alone (not visible/no line of site from any other person) in a laboratory or chemical storage area unless other employees are in the vicinity (either in an adjacent room or immediately across a hallway – capable of hearing a call for help) and are aware that someone is in the laboratory, in which case periodic checks should be made. At no time should a student ever work alone in a laboratory or chemical storage area. Students shall never be left unsupervised in a laboratory or chemical storage area.

Whenever chemicals are in the laboratory and not in locked cabinets or storerooms, the unattended laboratory will be locked.

4.3 Personal Protective Equipment and Clothing

The employee should use appropriate protective clothing and equipment. Laboratory aprons or coats, eye protection, and nonpermeable gloves are considered standard equipment for school laboratory programs and should be readily available to employees. Required personal protective equipment must be supplied by the College.

4.3.1 Eye Protection

Everyone, including visitors to the laboratory, should wear eye protection at all times, when working with chemicals.

Protective eyewear should provide splash and impact protection and should conform to ANSI Standard Z87.1-1989. Prescription eyeglasses, even with side shields, are not acceptable protection against impact and chemical splashes.

Equipment should be available with which to clean and sterilize goggles and/or safety glasses and should be used whenever two or more persons use the same protective eyewear. It is recommended that a sterilization cabinet be available, particularly for use with goggles shared by students.

Contact lenses are not necessarily prohibited in the laboratory. If contact lenses are permitted, chemical splash goggles must be worn at all times when chemicals are being used and there is a potential for explosions, implosions, splashes, or whenever corrosive liquids are in use. Because there may be a need to remove contacts quickly, contact lens wearers must inform the appropriate personnel of the contacts before an emergency arises. Approved standing shields or face shields

should be used when there is potential for explosions, implosions, or splashes, or when corrosive liquids are used, in addition to appropriate protective eyewear (i.e. goggles or safety glasses).

4.3.2 Protective Clothing

Protective clothing worn in the laboratory should offer protection from splashes and spills and should be easy to remove in case of an accident and should be fire resistant. They should be long enough to cover from the neck area to the knees. Clean chemical and fire resistant laboratory coats may be worn. They should be long-sleeved and long enough to cover the knees. Snap fasteners or Velcro closures are better than buttons, because the laboratory coat is more easily removed in an emergency.

It is recommended that shorts, cutoffs, or short skirts not be allowed to be worn in the laboratory. Shoes should have low heels with fully covered "uppers." There should be no open toes or uppers constructed of woven material. Jewelry such as rings or bracelets should not be worn in order to prevent chemical seepage under the jewelry, contact with electric sources, catching on equipment or damage to the jewelry itself.

Laboratory coats, jackets, aprons, or clothes on which chemicals have been spilled should be washed separately or disposed of (possibly as a hazardous waste, depending on the contamination source).

4.3.3 Gloves

When gloves are required, it should be remembered that no one kind of glove is suitable for all situations. The SDS should be consulted for information regarding the proper type of gloves to be used. For example, corrosion-resistant gloves should be worn when working with corrosive liquids.

Gloves that resist permeation by chemicals that are allergenic, sensitizing, or toxic should be worn when appropriate.

Gloves should be removed before leaving the laboratory or touching door knobs, telephones, or laboratory notebooks.

Gloves should be checked before each use to ensure the absence of cracks and small holes and should always be worn with the same side out.

4.4 Advance Planning

The employee should not rely solely on the textbook, laboratory manual, or other instructional material for safety precautions required for a particular experiment. Consult the SDSs for chemicals and safety references for equipment, particularly when the anticipated experiment is new to the instructor. The instructor or laboratory technician should review potential hazards and specifically describe them to all classes and all students immediately before each experiment.

The scale of the procedure should be reduced as much as possible to bring to a minimum the generation of waste chemicals. Use only those chemicals for which the ventilation system is adequate.

4.5. Personal Behavior

The laboratory should never be left unattended while students are performing an experiment in that laboratory. However, it is recognized that some experimental procedures, such as crystallization or incubation, are a normal part of some experiments and that such procedures may safely be left while they are in progress. The employee should use the best available information when deciding whether a particular procedure may be left unattended. Additionally, activities using unauthorized chemicals should not be performed by employees or students.

Horseplay, pranks, or other acts of mischief should not be tolerated in chemical work areas and laboratories.

Every precaution should be taken to insure that chemicals are never removed from the laboratory by unauthorized persons.

4.6 Personal Hygiene

All employees should use appropriate personal hygiene practices, including the following:

- Wash promptly whenever any hazardous chemical has contacted the skin, except in those few cases in which chemicals will react dangerously with water.
- Never pipet by mouth. Always use a bulb or other device for suction.
- Avoid inhalation of chemicals used for an experiment, including gases, vapors, and aerosols.
- "Wafting" to test chemical odors should only be done with extreme caution and only when specifically directed to do so in the written experimental procedure.
- Wash well with soap and water before leaving the laboratory, even if gloves have been worn.
- Never wash with organic solvents.
- Never smoke in the laboratory. Be aware that tobacco products in opened packages can absorb chemical vapors.
- Do not apply or store cosmetics in the chemical laboratory.
- Seek immediate and appropriate medical treatment whenever signs or symptoms of exposure to a hazardous chemical are manifested.

4.7 Housekeeping

Because many accidents may be attributed to sloppy work areas, all laboratory spaces must be kept clean and contain only those items needed for the task at hand. Cleanup should immediately follow the completion of each operation and at the end of each day.

- Place all wastes in appropriate, segregated receptacles that are correctly labeled.

- Store all equipment and chemicals properly. Chemicals should not be stored in aisles, on the floor, in stairwells, on desks or laboratory tables.
- Do not leave chemicals overnight on shelves over the workbench.
- Never block access to emergency equipment, showers, eye washes, or exits.
- Clearly label all chemical containers with the identity of the contents and the hazards those contents present. These labels should be consistent with all state and federal requirements.
- Keep all cabinets and drawers closed when not in use to avoid catching and bumping hazards.
- Clean all working surfaces and floors on a regular basis. Keep the floor clear of slipping hazards such as ice, spilled liquids, glass beads, or other small items.
- Clean up all chemical spills as soon as they occur. Chemicals and cleanup materials should be disposed of correctly.

4.8 Food Handling

No food or beverages should be stored, handled, prepared, or consumed in the laboratory or other areas where chemicals are used or stored. Additionally, laboratory chemicals and laboratory equipment should not be brought into designated "non-laboratory" or eating areas. Glassware or utensils that have been used for laboratory operations should never be used to prepare or consume food. Laboratory refrigerators, ice chests, microwave ovens, and cold rooms should not be used for food storage or preparation.

4.9 Glassware

Careful storage and handling procedures should be used to avoid glassware breakage. In the event of breakage, protection for the hands should be worn when picking up the broken pieces. Small pieces should be swept up with a brush and pan. Broken glass should be separated from other waste by placing it in a special container marked 'Broken Glass'. Broken glass contaminated with chemicals may need to be treated as hazardous waste depending on the type of chemical – consult with the Environmental Health and Safety Officer for assistance.

When inserting glass tubing into rubber stoppers or corks or when placing rubber tubing on glass hose connections, adequate hand protection in the form of heavy gloves or cloth towels should be used. When inserting glass tubing into a stopper, the hands should be held close together to limit movement of glass, and the glass should be lubricated. Tubing should be fire polished or rounded at the end.

4.10 Flammability Hazards

Open flames should not be used to heat a flammable liquid or to carry out a distillation under reduced pressure. Before lighting a flame, all flammable substances should be removed from the immediate area of the flame. All containers of flammable substances in the area should be checked to ensure that they are tightly closed.

Flammable materials should be stored in a flammable liquid storage cabinet or other appropriate location. When transferring significant quantities of flammable liquids from one container to

another, it is particularly important that they be properly grounded to prevent accidental ignition of flammable vapors and liquids from static electricity or other sources of ignition. Large quantities of flammable chemicals stored outside cabinets should be in flame-proof storage cans which conform to NFPA (National Fire Protection Association) guidelines. NFPA Standards 30, Flammable and Combustible Liquids Code, and 45, Fire Protection for Laboratories Using Chemicals, and/or the applicable local fire codes should be followed.

4.11 Electrical Hazards

All electrical outlets should have a grounding connection accommodating a three-prong plug. Most electrical equipment is wired with a three-prong plug. The grounding post should never be removed from such a plug. Some equipment is designed for safe use with two-prong plugs. If the appliance comes with a two-prong plug, there is no need to change; it will work in a three-prong socket.

Employees should contact the Physical Plant in the case of an emergency for considerations that electrical service to the laboratory need to be cut, or if power goes out due to unforeseen circumstances. Laboratory lighting should be on a separate circuit from electrical outlets with a minimum of 90-minutes of illumination, so that electric service can be cut off during an emergency, if need be, and particularly for exit routes. All electrical outlets should be checked for continuity after initial occupancy (upon new construction or when first used by an employee) and whenever electrical maintenance or changes occur.

If electrical equipment shows evidence of undue heating, it should be immediately unplugged.

4.12 Compressed Gases

If compressed gas cylinders are used in the laboratory, procedures for their use and storage should be in accordance with guidelines established by:

- National Fire Protection Association (NFPA) Standard 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders*;
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) recommended guidelines;
- Compressed Gas Association (CGA) Standard P-1 2008; and,
- OSHA Subpart H (specifically 1910.101 – 1910.105) regulations (provided as Appendix B).

Some of the more important considerations in using gas cylinders correctly are the following:

- No cylinder should be moved from one location to another until the protective cap is securely in place.
- Both full and empty cylinders should only be stored where they may be securely restrained by straps, chains, or a suitable stand.
- All cylinders should be used with a correct regulator, and should be fitted with delivery tubes that do not leak and which are tightly fastened to the cylinder.

- A cylinder may be considered to be empty when there is still a slight positive pressure.
- An empty cylinder should be returned to the supplier as soon as possible after having been emptied, or when it is no longer needed.
- Cylinders should not be exposed to temperatures above 50 °C (122 °F).

4.13 Prior Approval

Professors and technical staff may need to obtain prior approval from the Chemical Hygiene Officer whenever a new laboratory experiment or test procedure is to be carried out for which the potential for harm (conditions for which are identified below), either chemical, physical or biological, is present. The potential for harm may be affected by a change in the amounts of materials being used, the conditions under which the experiment is to be conducted, or the substitution, deletion, or addition of a chemical.

Prior approval may be needed using the form provided as Appendix C and AFTER consultation with the Chemical Hygiene Officer before doing any procedure where one or more of the following conditions exist (generally under normal temperature and pressure):

- Potential for a rapid rise in temperature.
- Potential for a rapid increase in pressure.
- Potential for chemical explosion.
- Potential for spontaneous combustion.
- Potential for the emission of toxic gases that could produce concentrations in the air that exceed toxic limits.

Prior approval should also be obtained before again performing any procedure after there has been a failure of any of the equipment needed for the process, especially of safeguards such as fume hoods.

Section 5: RECORD-KEEPING PROCEDURES

The College should maintain specific records to verify safety practices.

5.1 Air Concentration Monitoring

The College requires that records of air concentration monitoring be maintained for at least 30 years and that they be accessible to employees and/or their representatives. Such monitoring should be done as recommended by the Chemical Hygiene Officer and follow generally accepted monitoring techniques.

Regular instrumental monitoring of airborne concentration is not usually justified or practical in school laboratories. Monitoring may be appropriate when toxic materials are used or stored, or when ventilation devices are tested or redesigned. It is required after each documented incident of exposure to toxic chemicals.

5.2 Training Records

The College should maintain records of employee training for at least 30 years and should make those records available to employees and/or their representatives when requested.

5.3 Safety Data Sheets

The College should maintain a file of manufacturers' SDS's and should make them accessible to employees in the laboratory. If a SDS is not available when a new chemical is received, that chemical should not be used until a SDS is obtained. It is recommended that copies of SDSs be kept at both the Environmental Health and Safety Office and the Department where the chemical is located. See Section 6.9 for more information.

5.4 Exposure Testing Records

Records of exposure assessments should be maintained for at least 30 years, and they should be made available to employees and/or their representatives upon request. Exposure testing procedures and results of that testing should be sent to the Chemical Hygiene Officer, who is responsible for maintaining these records.

An accurate record of any measurements taken to monitor employee exposures should be kept, transferred, and made accessible to each employee. Each employee should be notified of any monitoring results within 15 working days after receipt of the results, either individually, in writing, or by posting the results in an appropriate location that is accessible to employees.

5.5 Medical Records

The College requires the records of medical consultations, medical examination, and all reports derived from such consultations and examinations be maintained for at least 30 years. These records must be accessible to employees and/or their representatives upon request and **are subject to Federal and State privacy laws, statues and regulations, including but not limited to the Health Information Portability and Accountability Act (HIPAA) and Family Education Rights and Privacy Act (FERPA).**

5.6 Prior Approval

Laboratory employees should be informed of those laboratory procedures and operations which require prior approval from the Chemical Hygiene Officer (see Section 4.13), so that these activities can be carefully monitored for adherence to the Chemical Hygiene Plan. Request for approval must be made in writing, using the form provided in Appendix C.

5.7 Incident Reports

Each incidence of an accident of injury or "near miss" should be reported to the Chemical Hygiene Officer (and to the Environmental Health and Safety Officer if he/she does not carry

both designations) in writing in accordance with Worker's Compensation rules. If staff or students were witnesses to the accident of injury, they should also complete the appropriate form found in Appendix D (also available on the College's website). The College should keep records for 30 years from the time of the lost work, in the event of lost work resulting from an exposure to a hazardous chemical or a job-related accident. Near miss reports are very useful in determining what areas might benefit from a review of procedures.

5.8 Chemical Inventory Records

Each department should maintain a Chemical Inventory List, which should be updated at least annually. Copies of the Chemical Inventory List should be kept in the Department and by the Chemical Hygiene Officer. If this is done by a computer-based inventory program, backup copies should be maintained in a separate location. See Section 6.7 for more information.

5.9 Waste Disposal Records

The College should maintain records of waste chemicals and products from reactions or processes that are transferred to an authorized and/or certified chemical disposal agent, and chemicals that are transported to a new site. These records should conform to requirements of the Environmental Protection Agency and Department of Transportation, either of which may have jurisdiction over these types of transfers. The records should also conform to State requirements.

5.10 Safety Inspections and Recommendations

The College should keep records of regular safety inspections, including the date of the inspection and the person conducting the inspection. The College should keep records of permanent safety equipment, showing the dates of inspection and the results of any inspection. Examples of equipment to be inspected are fire extinguishers, drench showers and eye wash fountains. The College should maintain records showing dates of needed repairs and regular maintenance for control systems.

Written safety suggestions from employees should be recorded by the College. The dates the suggestions were submitted, the name of the person submitting the suggestion, the disposition of the suggestion, and the reasons for that particular action should be kept.

Section 6: LABORATORY SAFETY PROCEDURES

6.1 Employee Exposure Protection and Monitoring

If there is reason to believe that exposure levels for a regulated substance have exceeded the action level or permissible exposure limit, the College's Chemical Hygiene Officer should ensure that employee or student exposure to that substance is measured.

Factors which may raise the possibility of overexposure and therefore warrant an initial measurement of employee or student exposure include:

- The manner in which the chemical procedures or operations involving the particular substance are conducted.
- The existence of historical monitoring data which shows elevated exposures to the particular substance for similar operations.
- The use of a procedure which involves significant quantities or is performed over an extended period of time.
- There is reason to believe that an exposure limit may be exceeded.
- Signs or symptoms of exposure (e.g., skin or eye irritation, shortness of breath, nausea, or headache), which are experienced by employees or students. (Some of these symptoms are very general and can be due to many other causes including emotional stress or hysteria.)

If the initial exposure determination described above indicates employee or student exposure over the action level for a particular substance, the College should immediately comply with the exposure-monitoring requirements for that substance.

6.2 Laboratory Facilities

The type and scale of work conducted in a laboratory should be appropriate to the physical facilities available and to the quality of the ventilation system. A laboratory should include, where appropriate:

- An adequate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air.
- Well-ventilated stockrooms and storerooms.
- Proper chemical storage for specific hazardous materials such as flammables, corrosives, carcinogens, and highly toxic chemicals, so far as they are likely used.
- Adequate laboratory hoods and sinks.
- Emergency equipment, including proper fire extinguishers, spill kits, alarms, access to a telephone with an outside line, eye wash, safety shower, and fire blanket.
- First aid equipment including first aid kits.
- Arrangement for proper waste storage and disposal.

6.3 Laboratory Ventilation

Laboratory fume hoods are not meant for either storage or disposal of chemicals. If a hood must be used for storage, in order to provide adequate ventilation for flammable chemicals, for example, it must not be used for laboratory experiments or transfer of chemicals unless safe use for chemicals within can be demonstrated. In the event it cannot be demonstrated that safe use can also be achieved, it must be used only for storage.

General laboratory ventilation should not be relied on for protection from exposure to hazardous chemicals. A rate of 8–12 room air changes per hour should be the accepted standard when local

exhaust systems such as hoods are used as the primary method of control. Laboratory airflow should not be turbulent and should flow continuously throughout the laboratory.

The quality and quantity of ventilation should be evaluated when installed, regularly monitored, and reevaluated whenever a change in ventilation devices is made, or the ventilation system is repaired.

6.4 Medical Consultations and Medical Examinations

Employees who work with hazardous chemicals should be provided with an opportunity to receive medical attention when overexposure to a hazardous chemical is reasonably suspected.

In the event that employees' work involves regular and frequent handling of toxicologically significant quantities of a chemical, the Chemical Hygiene Officer should determine whether consultation with a qualified physician is necessary to set up a plan for routine surveillance.

Cause for Consultation or Examination

In relation to the exposure of hazardous chemicals, medical attention should be provided to an employee under the following circumstances:

- Whenever an employee develops signs or symptoms of exposure to a hazardous chemical to which the employee may have been exposed in the laboratory.
- Whenever exposure monitoring reveals an exposure level above the action level or permissible exposure level for an OSHA-regulated substance.
- Whenever an event such as a spill, leak, or explosion, takes place in a laboratory which results in the likelihood of exposure to a hazardous substance.

Type of Medical Attention

All medical examinations and consultations should be performed under the direct supervision of a licensed physician and in full accordance with 29 CFR 1910.1450(g).

Information for the Physician

The following information should be provided to the physician conducting medical consultations and examinations:

- The identity of hazardous chemicals to which the employee may have been exposed.
- A copy of the safety data sheet for the chemical.
- A description of the conditions under which the exposure occurred, including quantitative exposure data.
- A description of the signs and symptoms of exposure that the employee is experiencing.

Physician's Report

A written opinion from the examining physician specializing in occupational medicine for any consultations or examinations performed under this standard should include any recommendation for further medical attention, the results of the medical examination and any associated tests, any medical condition revealed during the examination which might compromise employee safety during, or as a result of, exposure to hazardous chemicals found in the workplace, and a statement that the employee has been informed by the physician of the results of the consultation or examination and any medical condition that may require further examination or treatment. The written opinion should not reveal specific diagnoses unrelated to occupational exposure, except as noted above.

6.5 Chemical Purchase and Procurement

The purchaser of chemicals should be guided by the maxim that less is better. The lower the chemical inventory, the fewer the problems associated with storage, and the less likely that the College will face excessive costs to dispose of outdated or surplus chemicals.

- Chemicals should be ordered in quantities that are likely to be consumed in one year or less.
- Chemicals should be purchased only when needed for specific experiments or research projects. The chemicals should be purchased only in the quantity sufficient for the declared use.
- All chemicals should be in tightly closed, sturdy, and appropriate containers.
- A chemical should not be accepted without being accompanied by the safety data sheet.
- The container should be marked with the date at the time it is received and the date it is opened.
- Chemicals should not be accepted if the original container has been broken, opened, or has been compromised in some other way.
- The Chemical Inventory List should be updated each time a new chemical is received.
- Donated chemicals should be accepted only after approval is obtained from the Chemical Hygiene Officer. It should be established that the donated chemical is in excellent condition, that an appropriate safety data sheet is available, and that there is a specific use for the donated material.

6.6 Storage and Distribution

- All chemicals should be in tightly closed, sturdy, and appropriate containers.
- If the chemical has been transferred to a secondary container, the new container should be appropriately labeled, including all of the hazard information. Specifications for labeling follow in Section 6.8.
- Chemicals should be stored based on the reactive nature of the chemical. Storage patterns should never be based solely on the alphabetical arrangement of chemicals.
- The classification system used for the storage of chemicals should be displayed in the principal storage area.

- Large containers and containers with reactive chemicals, such as acids and bases, should be on low shelves. No chemical should be stored on top of a storage shelf or cabinet.
- All shelves on which chemicals are stored should have a lip of approximately 3/4" or greater in order to prevent bottles from sliding off the shelf.
- Flammable chemicals should be stored in approved storage cans or approved flammable chemical storage cabinets.
- Combustible packaging material should not be stored near flammable chemical storage cabinets.
- All storage areas should be securely locked when not in use by the employee. Storage and preparation areas should be accessible only to those persons authorized to use the chemicals. Such personnel should have had proper training in the handling and use of the chemicals.
- Chemicals classified as acute poisons should be kept in a separate, locked location, which has been appropriately labeled.
- Chemicals which present a fire hazard should be stored in quantities less than 500 mL, unless metal safety cans are used, or the container is stored in a suitable flammable storage cabinet.
- If approved metal safety cans are used, the spring-loaded closure should not be disabled, the flame-arrestor screen should be kept in place, the arrestor screen should be replaced whenever it is punctured or damaged, and the arrestor should never be immersed in the flammable liquid.
- Chemicals should not be distributed to other persons or to other areas of the College without prior approval of the Chemical Hygiene Officer. Chemicals should not be transferred to another location without the simultaneous transfer of a copy of the appropriate safety data sheet, nor should they be transferred without the person receiving the chemicals having had appropriate training in their use, storage, and disposal.

6.7 Inventory Control

Various regulatory agencies require the College to maintain a complete, accurate and up-to-date inventory of its toxic and hazardous materials. Primarily though, inventories are essential to inform individuals which chemicals they may have the potential to be exposed to, further allowing them to better understand the associated hazards and risks of these chemicals.

Each department head or designee is responsible for ensuring that a chemical inventory list of the hazardous chemicals and toxic substances used, stored or otherwise kept in each laboratory or work area under his/her purview is created and maintained.

A good way to prepare a comprehensive inventory list is to survey your work area(s) to do a physical assessment, and purchasing records also may help. The broadest possible perspective should be taken when doing the survey. Considering all substances to be potentially toxic and hazardous simplifies the approach even though it may unnecessarily include a few materials that are essentially non-hazardous.

Items NOT REQUIRED to be Inventoried:

Even though some items may not be entered into the inventory, the user is still responsible to obtain a current Safety Data Sheet (SDS) for the product. The list below provides some examples of common materials that do not need to be inventoried.

- Any secondary chemical container that is produced in the lab from a primary chemical container(s) *that is already inventoried*, for example:
    - 1N Sodium Hydroxide (NaOH) that is made from a commercially available 10N NaOH solution or solid NaOH
    - Squirt bottles and spray bottle
    - Conical and "Falcon" tubes with chemicals or samples in them
- Biological material, for example:
    - Plant or animal tissue, blood or blood products
    - Reproducing biological organisms, bacteria, viruses, fungi or yeast
    - Enzymes, antibodies, proteins, peptides, nucleic acids
    - Conjugated antibodies and proteins
- Tissue culture media or other growth media
- Buffer solutions for pH probes
- Non-chemical diagnostic materials that contain a film on any surface (e.g. 96-well plate)
- Chemical spill kits

Inventories must be completed in a Microsoft Excel template available from the Environmental Health and Safety Officer, or one can be downloaded through links included in the Chemical Inventory Management section of FSC's Environmental Health and Safety website. The Chemical Inventory List should contain the following information about each chemical found in storage: Product Name; Synonyms or Other Names (If known/available); Manufacturer, Catalog (Cat.) No., Chemical Abstracts Service (CAS) No., and/or Other Identifying Information; Physical State (Solid, Liquid or Gas); Number of Containers of same type/size; Quantity (volume/weight); and the Unit of Measure (lbs, Kg, mg, etc.).

Once a chemical inventory has been completed, the electronic file MUST be emailed to the Environmental Health and Safety Officer at ehs@farmingdale.edu.

Each chemical inventory list must be updated at least annually, or whenever there is a substantial change (i.e. a chemical is added or removed). After each annual update, and whenever there is a change made, a revised chemical inventory MUST be emailed to the Environmental Health and

Safety Officer at ehs@farmingdale.edu and, where possible, the revised section or reason for change be highlighted, marked up, explained, etc. for ease of rectification.

Upon receipt by the Environmental Health and Safety Officer, the chemicals included on the spreadsheet will be added to the College's Chemical Inventory and Management System, MSDSonline, where all chemicals inventoried on Campus are listed. In addition, MSDSonline also provides access to associated Safety Data Sheets, identifies where these chemicals are stored and communicates pertinent health and safety information (among other features) aimed at better communicating the hazards and risks associated with the chemicals used and stored on Campus.

6.8 Hazard Identification and Labels

- Laboratory chemicals should be properly labeled to identify any hazards associated with them for the employees' information and protection.
- If a chemical is stored in its original bottle, it should have the manufacturer's original label identifying potential hazards, and the date of purchase, the date opened, and the initials of the person who opened the container.
- If a chemical has been transferred to a secondary container, the new container should be appropriately labeled with the chemical name, formula, concentration (if in solution), solvent (if in solution), hazard warnings, and name or initials of the person responsible for the transfer.
- Unlabeled bottles should not be opened, and such materials should be disposed of promptly, as outlined in the section on disposal procedures.

6.9 Safety Data Sheets

The Hazard Communication Standard requires chemical manufacturers and importers to evaluate the hazards of the chemicals they produce or import. Using that information, they must then prepare more detailed technical bulletins called Safety Data Sheets, or SDSs.

The SDSs for each chemical used in the laboratory should give recommended limits or OSHA-mandated limits, or both, as guidelines to exposure limits. Typical limits are expressed as threshold limit values (TLVs), permissible exposure limits (PELs), or action levels. When such limits are stated, that limit, along with any other information about the hazardous characteristics of the chemical, should be used to set laboratory guidelines. These laboratory guidelines may be used by the Chemical Hygiene Officer and the department technical staff in determining the safety precautions, control measures, and personal protective equipment that apply when working with that toxic chemical.

Each department head or designee is responsible for maintaining a manufacturer-specific SDS for each hazardous or toxic substance used or stored in his/her work area(s), and for ensuring that they are readily accessible during each work shift to employees when they are in their work area(s).

In lieu of maintaining hard copies of SDS's (i.e. binder, folder, cabinet, etc.), electronic versions will be available through MSDSonline, Farmingdale State College's Chemical Inventory and Safety Data Sheet service provider.

Please note, MSDSonline may ONLY be used as the SOLE SDS resource if ALL employees with the potential for chemical exposure in any given area have full access (i.e. computer access, a general understanding of how to navigate the system, etc.) to the service; otherwise, hard copies must be made readily available as well.

Each department head or designee must also send copies of all SDSs for new chemicals as they arrive to the Environmental Health and Safety Officer. This can be done one of two ways:

1. Access the MSDSonline site through links included in the Safety Data Sheet (SDS) Management section of FSC's Environmental Health and Safety website and enter the product name you're seeking to submit an SDS for in the search engine (you can narrow down your search by also including such information as the CAT. Number, the CAS Number, the Manufacturer, etc.) - if your initial search is not successful, try adding or removing information you've included in the search field and resubmit.

Once you've found the correct SDS, check the box associated with that product (left of product name) which prompts you to select "Assign to Company List"; click on that prompt, which opens up a second screen.

Fill out all required information on this "Approval Details" page and hit 'submit'. Your submission will be sent to a queue for the System Administrator's approval (the EH&S Officer). Please note: if your specific location is not listed in the drop down menu on the "Approval Details" page, call or email the EH&S Officer so that it can be added.

2. SDSs may be emailed to the EH&S Officer at ehs@farmingdale.edu, or, the SDS(s) can be faxed to the attention of the Environmental Health and Safety Officer at (934) 420-9173. Whichever means is used to submit the SDS, be certain to add under separate cover details that include the specific location where the chemical(s) are to be used/stored - identify the Building, Department, Room Number and the Specific Location (i.e. cabinet A, stockroom, under fume hood #1, etc.). Once received, the proper SDS will be "paired" with the associated chemical(s) within MSDSonline, and hard copies will be maintained on file.

SDSs should be reviewed prior to purchase to properly evaluate the hazards and risks associated with the substances being considered for use. As part of the college's ongoing Hazard Communication Training Program, all laboratory employees will be trained to read and understand the SDSs.

Each department head or designee is responsible for ensuring that an appropriate SDS is forwarded with each initial product shipment. SDSs are also requested for purchases made through the Research Foundation. If the SDS is not received with the initial shipment, it is the responsibility of the ordering entity (department head/designee) to contact the supplier (manufacturer/importer/distributor) and acquire an SDS, put a copy in the department's SDS binder, file, or appropriate area, and/or send a copy of the SDS to the Environmental Health and Safety Officer as explained above.

In addition, each department head or designee is responsible for ensuring that SDSs that have been replaced with a newer version and/or SDSs of discontinued materials are retained in accordance with the General Retention and Disposition Schedule for NYS Government Records,

and other applicable laws and regulations. As a general rule, SDSs are retained for at least 40 years after superseded or obsolete.

Alternatively, if SDSs are/have been forwarded to the Office of Environmental Health and Safety, they will be maintained there for the required time period, and/or, will be "banked" in the MSDSonline service database, which will be backlogged/archived/saved at least annually.

6.10 Waste Disposal

The College's Chemical Hygiene Officer should ensure that laboratory chemicals are disposed in compliance with appropriate regulations and in a manner which minimizes damage to human health and the environment.

Every process that uses chemicals has the potential for producing hazardous waste. The purchaser or producer of chemicals should take into consideration the waste that should be produced and the cost of waste disposal. The product of a reaction or process only becomes hazardous waste when it is removed from the reaction system, deemed to be a "waste" and is a hazardous material (meets the definition of "hazardous waste"). Disposal of hazardous waste must be done by a licensed contractor through a permitted facility.

The following are specific guidelines for hazardous waste disposal:

- Chemicals should be ordered in quantities that are likely to be consumed in one year or less.
- Potential waste materials are surplus, old, and/or unnecessary chemicals. Every attempt must be made to avoid accumulating such chemicals.
- No flammable, combustible, or water-immiscible material will be poured down the drain unless specifically allowed for by law and with prior approval by the Chemical Hygiene Officer.
- Separate waste containers should be provided for heavy metal compounds, chlorinated hydrocarbons, and nonchlorinated hydrocarbons. Separation of wastes in this manner will make disposal less costly.
- Acids and bases may be neutralized before disposal down the drain only with prior training and approval by the Chemical hygiene Officer.
- Hazardous waste should never be placed in the common solid trash container(s).
- Waste chemicals should be stored in appropriately labeled containers, inside secondary containment.
- The products of projects, experiments, or other chemical procedures should be recycled and/or decontaminated whenever possible.
- All waste containers should have an up-to-date log of the material that is in the container. Each entry for an addition to the container should be dated and initialed by the instructor, or person who puts the waste in the container. The entry should provide the correct chemical name and amount of chemical added.
- When feasible and safe, a large container of a given waste should be used instead of several small containers of the same material for financial reasons.

- Waste materials should not be allowed to accumulate in laboratories or preparation rooms. The sealed containers should be removed to the designated waste storage location. There are regulatory limits depending on quantity which need to be verified with local officials.
- Waste materials should be identified using a chemical identification form and/or label ensuring sufficient information for their safe transportation, treatment, storage, and disposal.
- The disposal of hazardous wastes should follow the guidelines established by the appropriate local, State, and federal regulations.

Section 7: PROCEDURES FOR INSPECTIONS

All employees should be alert to unsafe conditions and should inform the Department Chair and the Chemical Hygiene Officer in writing, when an unsafe condition occurs.

7.1 Laboratory Equipment

The presence of necessary safety equipment, in proper working condition (a reference list of which is provided in Appendix E), should be maintained in each department and laboratory area and assessed at least biannually. Safety equipment should be replenished/replaced as soon as feasible if found to be missing, used or obsolete. The following general standards will apply:

- Each hood will have a face velocity of 60–100 linear feet per minute.
- Each shower will be capable of supplying a continuous flow of tepid, potable water. (ANSI Standard Z358.1-1990)
- Every eye wash will be capable of supplying a continuous gentle flow of aerated, tepid, potable water to both eyes. (ANSI Standard Z358.1-1990)
- Each fire extinguisher will be fully charged.
- Every goggle sanitizer will have its UV bulb and timer operating properly.
- Equipment will be tagged following the inspection, showing the date, inspector, and results.

7.2 Safety Inspections

Inspections in the laboratory shall be conducted at least annually. Inspection records will be kept by the Department Chair and Chemical Hygiene Officer. A form for conducting these inspections is shown in Appendix F. Laboratory inspections will be coordinated by the Chemical Hygiene Officer.

Written (or digital) records of all inspections will be maintained by the Chemical Hygiene Officer.

Section 8: SPECIFIC EXPOSURE CONTROL MEASURES

This section addresses criteria that would invoke the use of specific exposure control measures, which are more stringent than those procedures specified as standard operating procedures or general laboratory safety rules. These specific exposure control measures are designed to reduce the exposure of instructors, aides, students, and other employees to especially hazardous

chemicals. Employees should read and understand these practices before commencing a procedure using one or more of these chemicals.

8.1 Toxic Chemicals

The SDSs and labels for many of the chemicals used in the laboratory recommend specific limits for exposure. Other limitations may be specified by OSHA-mandated limits. Typical limits are threshold limit values (TLVs), permissible exposure limits (PELs), and action levels. When such limits are stated, they should be used to assist the Chemical Hygiene Officer and the technical staff in determining the safety precautions, control measures, and safety apparel.

When a TLV or PEL value is less than 50 ppm or 100 mg/m3, the user should use it in an operating fume hood, glove box, vacuum line, or other device equipped with appropriate traps. If none are available, no work should be performed using that chemical.

If a TLV, PEL, or comparable value is not available, the animal or human median inhalation lethal concentration information, LC50, should be used as a guideline. If that value is less than 200 ppm or 2000 mg/m3 when administered continuously for one hour or less, then the chemical should be used in an operating fume hood, glove box, vacuum line, or similar device, equipped with appropriate traps. In none are available, no work should be performed using that chemical.

Whenever laboratory handling of toxic substances with moderate or greater vapor pressures is likely to exceed air concentration limits, work with such liquids and solids should be conducted in a fume hood, glove box, vacuum line, or similar device, equipped with appropriate traps. If none are available, no work should be performed using that chemical.

Examples of toxic chemicals that were commonly used in the past are benzene, chloroform, formaldehyde, bromine, carbon disulfide, carbon tetrachloride, cyanide salts, and hydrofluoric acid. The use of these chemicals has been substantially reduced in the past few years because of their toxicity.

8.2 Flammable Chemicals

In general, the flammability of a chemical is determined by its flash point, the lowest temperature at which an ignition source can cause the chemical to ignite momentarily under certain controlled conditions.
Chemicals with a flash point below 200°F (93.3°C) should be considered “fire-hazard chemicals.” Any chemical whose SDS or label states “Flammable” is in this category.

OSHA standards and the National Fire Protection Association (NFPA) guidelines or local fire regulations should be consulted on the proper use of flammable chemicals in the laboratory. Specific references are found in Appendix G.

Fire-hazard chemicals in excess of 500 mL should be stored in a flammable solvent storage area, safety cans, or in storage cabinets designed for flammable materials.

Examples of commonly used flammable chemicals are diethyl ether, acetone, methanol, ethanol, glacial acetic acid, heptane, and petroleum ether (ligroin).

8.3 Reactive Chemicals

Reactivity information may be given in manufacturers' SDSs and on labels. The most complete and reliable reference on chemical reactivity is the current edition of Bretherick's Handbook of Reactive Chemical Hazards, edited by P.G. Urben, published by Butterworths. Other useful references are cited in Appendix G.

A potentially reactive chemical is one that:

- Is described as such on the label, in the SDS, or by Bretherick.
- Is ranked by the NFPA as 3 or 4 for reactivity.
- Is identified by the Department of Transportation (DOT) as an oxidizer, an organic peroxide, or an explosive (Class A, B, or C).
- Fits the Environmental Protection Agency (EPA) definition of reactive in 40 CFR 261.23.
- Is known or found to be reactive with other substances.

Reactive chemicals should be handled with all proper safety precautions, including segregation in storage and prohibition of mixing even small quantities with other chemicals without prior approval and appropriate personal protection and precautions.

Examples of commonly encountered reactive chemicals are ammonium dichromate, nitric acid, perchloric acid, hydrogen peroxide, and potassium chlorate.

8.4 Corrosive Chemicals and Contact-Hazard Chemicals

Corrosivity, allergen, and sensitizer information is provided in manufacturers' SDSs and on labels. Other guidelines on which chemicals are determined to be corrosive can be found in the publications cited in Appendix G.

A corrosive chemical is one that:

- Fits the OSHA definition of corrosive in 29 CFR 1910.1450 or 29 CFR 1910.1200.
- Fits the EPA definition of corrosive in 40 CFR 262.22 (has a pH greater than or equal to 12, or less than or equal to 2.5).
- Is known to be reactive to living tissue, causing visible destruction of, or irreversible alterations of, tissue at the site of contact.

A contact-hazard chemical is an allergen or sensitizer that:

- Is so identified or described in the SDS or on the label.
- Is so identified or described in medical or industrial hygiene literature.
- Is known to be an allergen or sensitizer.

Corrosive and contact-hazard chemicals will be handled with all proper safety precautions, including wearing safety goggles, gloves tested for the absence of pinholes and known to be resistant to permeation or penetration by the chemical, and a laboratory apron or laboratory coat.

Examples of corrosive chemicals are hydrochloric, sulfuric, nitric, phosphoric, and perchloric acids (all acids in greater than 1 Molar concentration), and potassium hydroxide (either solid or in aqueous solution of greater than 1 Molar concentration).

8.5 Reproductive Toxins

A reproductive toxin is a compound that:

- Is described as such in the applicable SDS or label, or;
- There is statistically evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic reproductive health effects may occur in exposed employees.

If such chemicals are used, they should be handled only in a hood and when satisfactory performance of the hood has been confirmed. Skin contact should be avoided by using gloves and wearing protective apparel. Persons using such substances should always wash hands and arms immediately after working with these materials. Unbreakable containers of these substances should be stored in a well-ventilated area and will be labeled properly.

Examples of reproductive toxins are organomercurial compounds and ethidium bromide, a reagent used with DNA analysis.

8.6 Select Carcinogens

All work with these substances should be conducted in a Designated Area, such as a fume hood, glove box, or portion of a laboratory designated for use of chronically toxic substances. Such a Designated Area should be clearly marked with warning and restricted access signs.

Any procedure that may result in a generation of aerosols or vapors should be performed in a hood whose performance is known to be satisfactory.

Skin contact should be avoided by using gloves and other protective apparel as appropriate. Any protective clothing should be removed before leaving the Designated Area and placed in a labeled container. Hands, arms, face, and neck should be washed after working with these materials.

Select carcinogens should be stored in unbreakable containers in a ventilated area with controlled access. All containers should be labeled with the identity and hazard of the substance. Immediately upon completion of the project, all unused reproductive toxin should be disposed of following standard hazardous waste disposal procedures.

Examples of select carcinogens are benzene, nickel metal dust, and vinyl chloride.

8.7 Exposure Potential

The routes of exposure to chemicals are inhalation, ingestion, contact with skin or eyes, or injection.

Inhalation of chemical vapors, aerosols, gases, or dusts can produce poisoning through the mucous membranes of the nose, mouth, throat and lungs. The degree of injury resulting from exposure to these chemicals depends on the toxicity of the material, its solubility in tissue fluids, its concentration, and the duration of exposure.

Ingestion is extremely dangerous. The relative acute toxicity can be evaluated by comparing the LD50, which is defined as the quantity of chemical that will cause the death of 50% of the test animals when ingested. Many chemicals will directly damage the tissue of the mouth, throat, nose, lungs, and gastrointestinal tract.

Contact with skin and eyes can lead to local irritation as well as significant chemical injury. In addition, many chemicals can be absorbed through the skin and may cause systemic poisoning. Alkaline materials, phenols, and strong acids can cause permanent loss of vision upon contact with the eye.

Injection of chemicals can occur through mechanical injection from glass or other materials contaminated with chemicals.

Section 9: TRAINING OPPORTUNITIES

The College should provide training opportunities for all employees. These training opportunities should include the transfer of information about the hazards of chemicals present in the laboratory and about sources of information. In particular, the training program should cover information found in the Laboratory Standard, manufacturers' safety data sheets, this Chemical Hygiene Plan, and the responsibilities of the employee.

Employees should be trained on the potential chemical hazards in the employees' work areas and on appropriate sections of the Chemical Hygiene Plan. This training should be provided to all employees who actually work in the laboratory as well as to other employees whose assignments may require that they enter a laboratory where exposure to hazardous chemicals might occur. Employees who are responsible for receiving and handling shipments of new chemicals or chemical wastes should also be informed of the potential hazards and appropriate protective measures for chemicals they may receive.

Employees should receive information and training at the time of their initial assignment to a laboratory and before assignments involving new exposure situations. Opportunities to refresh their working knowledge should be provided at least once a year. As indicated earlier, the training of laboratory personnel should be documented and made a part of the permanent record.

9.1 Information Program

Laboratory employees should be informed of at least the following information:

- The contents of appropriate governing standards, as shown in Appendix A.
- The location and availability of the Chemical Hygiene Plan.
- The location and availability of known reference materials on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory.
- The use and location of safety data sheets.

9.2 Employee Training Program

Laboratory employees should be trained on the applicable details of the Chemical Hygiene Plan, including a review of the general rules for laboratory safety. The training program should describe appropriate sections of the standard operating procedures, particularly those procedures that require prior approval of the Chemical Hygiene Officer. Employees should be informed as to the responsibilities of the Chemical Hygiene Officer responsible for the laboratory in which they work. Emergency procedures adopted by the College, including response to spills, fires, explosion, evacuation, and decontamination, should be described. Employees should be trained in measures they may take to protect themselves from exposure to hazardous chemicals, including the location and proper use of protective apparel and emergency equipment. In addition, the training must also include a discussion of inventory procedures to be followed, proper storage and ordering rules, and hazardous waste disposal procedures. A 'Record of Training' form is provided as Appendix H.

9.3 Training of Students

The College requires that instruction in laboratory safety practices be provided to all students involved in laboratory studies **before experiments take place.** Such training must be appropriate to their level of chemical handling and potential exposure to hazardous chemicals. The extent of training should be based on their grade level, courses of study, the laboratory facility, and the individual policies of the College as stated in the Chemical Hygiene Plan. The education of students is particularly important, because they are near the beginning of their experience with science, chemicals, and chemical safety. Instruction in safety should include the importance of the label and the SDS as important reference sources. As appropriate, the student should also be introduced to other sources of chemical safety information.

Section 10: EMERGENCY PREVENTION AND RESPONSE

10.1 Standard Emergency Procedures

Emergency procedures should address a failure in the ventilation systems, evacuation, fire and spill response, or the failure of other procedures to limit exposure of employees to hazardous chemicals. These emergency procedures should be established, regularly practiced, and should be posted in appropriate public places. These procedures should include the routes of egress

from the laboratory, procedures by which to notify appropriate individuals, and telephone numbers of fire, police, ambulance, and College authorities.

The laboratory should have a plan for everyone to follow if an evacuation is necessary. The employees should be sure that they know the main and alternative routes, as well as the procedure for accounting for each person after an evacuation. The most appropriate response to a serious fire is evacuation and subsequent action by the fire department.

10.2 Specific Emergency Response Procedures

When helping another person, employees should evaluate the potential danger to themselves before taking action. Do not move any injured persons unless they are in immediate danger from chemical exposure or fire.

Report the nature and location of the emergency to University Police by dialing (934) 420-2111. The employee should follow the facility's emergency response procedures. These procedures have been established, documented, and practiced.

Other important emergency response contacts, particularly when campus facilities and/or equipment are involved, a fire is evident or suspected, or if there is a threat of release of a hazardous substance to the environment:

FSC Physical Plant (7 a.m. – 4 p.m.): (934) 420-2017
FSC Heating Plant (after 4 p.m.): (934) 420-2605
FSC Fire Marshal: (934) 420-2603
East Farmingdale Fire Department: (631) 249-0047

10.3 First Aid

Suitable first aid equipment should be available in the laboratory area, including a blanket, a general first aid kit, and small bandages for minor cuts and abrasions. The College should have personnel trained in first aid available during working hours to render assistance until medical help can be obtained. Personal injury beyond the purely superficial requires professional medical treatment. Additional information may be obtained from the Red Cross or references in Appendix G.

10.4 Emergency Equipment

Each Department and the Chemical Hygiene Officer should ensure that adequate emergency equipment is available in the laboratory and inspected periodically to ensure that it is functioning properly. All personnel should be properly trained in the use of each item. It is recommended that students also be trained to use the fire blanket, eye wash fountain, safety drench shower, and telephone for safety purposes.

Equipment items that should be available in the laboratory include:

- Eye wash fountain.
- Fire extinguisher of an appropriate type.
- Safety drench shower.
- Telephone, with access to an outside line, for emergency response.
- Fire blanket.
- Identification signs.

10.5 Fire Prevention

The best way to fight a fire is to prevent it. Fires can be prevented or their severity considerably reduced by proper housekeeping and by thoughtful reflection about what is being done. This includes the prompt removal of waste, separation of flammable liquids from combustible material, storage of only limited quantities of flammable material, and the maintenance of unobstructed aisles and exits.

10.6 Dealing with a Fire

In preparation for dealing with a fire, a copy of the current Chemical Inventory List should be available outside the work area. Laboratories should be posted with the National Fire Protection Association (NFPA) diamond, which provides much emergency information. The information on the NFPA warning must be current. Since fires involving laboratory chemicals increase the possibility of explosions, special care should be taken to keep fire or excessive heat from volatile solvents, compressed gas cylinders, reactive metals, and explosive compounds.

If a fire occurs, the following actions should be followed, depending on its severity:

- A fire contained in a small vessel should be suffocated by covering the vessel. The vessel should not be picked up, nor covered with dry towels or cloths.
- Nearby flammable materials should be removed to avoid spread of the fire.
- If a fire burns over a larger area, all persons should evacuate the area, except those trained and equipped to fight structural fires.
- The fire extinguisher should be used only by trained people, and only from a position from which escape is possible.
- Stairs, not elevators, should be used to leave the area of the fire.
- The fire alarm should be activated and the fire department called.
- Firefighters should be informed of what chemicals are involved.

As soon as possible, all extinguishers that were used should be recharged or replaced with full extinguishers.

The facility’s fire protection plan should be documented and posted.

LOCAL PRACTICE MUST BE IN COMPLIANCE WITH LOCAL FIRE CODES.

10.7 Personal Injuries Involving Fires

Persons whose clothing is ablaze should STOP–DROP–and–ROLL. If a safety shower is immediately available, the individual may be doused with water. Once the fire is out, the individual should be wrapped to avoid shock and exposure. The individual should be kept warm, and medical attention should be promptly sought.

If a fire blanket is available, it should be used to smother the fire. The person should not be wrapped to avoid the chimney effect with the fire blanket.

10.8 Chemical Spills on Personnel

For spills covering small amounts of skin, the area should be washed immediately with flowing water for 15 minutes. To facilitate cleaning, jewelry should be removed. If there is no visible burn, the 15-minute wash with water is sufficient. If a burn is visible, medical attention should be sought after the washing has been completed. After washing, the SDS should be consulted to determine if any delayed effects should be expected. Depending on the information from the SDS, follow-up medical attention may be necessary.

For larger spills, the same procedures should apply, except that it may be appropriate to use the safety drench shower to assure thorough and complete washing.

For spills on clothing and whenever necessary, the clothes as well as shoes and jewelry to facilitate washing should be removed as quickly as possible. The safety drench shower should be used for 15 minutes and any affected skin should be thoroughly flooded for 15 minutes. The washing should be resumed if pain continues. No creams, salves, or lotions should be placed on the affected area, and medical attention should be sought as soon as possible.
Special care should be taken to prevent chemicals from entering the eyes. Contaminated clothes should be washed separately from other personal clothing, or disposed of as a hazardous waste (depending on the contamination source).

10.9 Splashes in the Eyes

Whenever potentially harmful chemicals enter the eye(s), the eye(s) should be immediately flushed with tempered potable water from a gently flowing source for at least 15 minutes. The eyelids should be held away from the eyeball, while the eyeball is moved up, down, and sideways to wash behind the eyelid(s). Assistance is absolutely necessary at this time. If contact lenses are worn, they should be removed as soon as possible to allow complete rinsing of the eye(s).

10.10 Dealing with Medical Help

Medical personnel should be fully informed about the chemical involved in the spill and the circumstances of the spill. Whenever possible a safety data sheet should be provided to the medical person providing assistance.

10.11 Other Accidents Involving Personal Injury

Anyone overcome with smoke or fumes should be removed to uncontaminated air and treated for shock. Potential rescuers should evaluate the possibility of harm to themselves before entering or remaining in a toxic environment.

If hazardous chemicals are ingested, the first aid treatment shown on the label or in the safety data sheet should be undertaken.

If an injured person is not breathing, the rescuer should provide mouth-to-mouth resuscitation, using appropriate methods. Special training is required to provide cardiopulmonary resuscitation (CPR). Consult the local Red Cross for details.

Bleeding should be controlled by compressing the wound with a clean cloth or other appropriate compress. However, because of the possibility of infection with one or more bloodborne pathogens, such as the HIV virus, adequate personal protection should be used. The injury should be elevated above the level of the heart. After bleeding is controlled, the injured person should be covered to avoid shock. Medical attention should be called for as soon as possible. If a person is in contact with a live electrical circuit, the power should be shut off at the most convenient switch. The person should not be touched until the power has been disconnected.

10.12 General Chemical Spills

All spills should be cleaned up promptly. Any individual at risk of involvement should be warned about the spill. Local procedures should be established and followed for determining when evacuation is necessary.

The spread of chemicals in a spill is important, and so absorbent material should be used to surround the spill area. After the spill has been contained, it can be cleaned up with appropriate tools, including commercial spill control kits, for example. If the spilled material is a hazardous chemical, that chemical and all the cleanup material must be treated as hazardous chemical waste and properly disposed.

10.13 Accident Reports

All accidents and near accidents should be carefully investigated. The results of that investigation and recommendations for the prevention of similar occurrences should be forwarded to the Department Chair and Chemical Hygiene Officer. Accident reports should be kept on file, as indicated in the record-keeping section of this document.

Section 11: SPILL RESPONSE PROCEDURES

11.1 Personal Injury

In the event of a spill, the first response should be to determine if anyone has come in contact with the spilled chemical. All persons who have been splashed should be assisted to the deluge shower. A minimum 15-minute rinse is indicated. Remember if clothing is splashed, it must all be removed, since the rinse is designed to remove chemicals only from the skin. Any suggestion of splash in the eyes requires a 15-minute rinse at the eye wash. Hold the eyelids open and allow the water to rinse the eye surface. If contact lenses are worn, they should be removed as soon as possible to allow complete rinsing of the eye.

11.2 Identification of the Spill

If the spill appears to be organic solvents, ammonia, or other volatile reagents, evacuate the area as soon as possible. Use fire drill procedures and ventilate the area. Be aware of the possibility of sparks from electrical switches, open flames, or other sources of ignition.

If the chemical involved in the spill is judged to present an immediate hazard, the evacuation is to be absolute, and the area isolated until a HAZMAT team is called.

11.3 Containment of the Spill

If there is no immediate danger to personnel, containment should be accomplished by use of spill pillows, towels, rolls, or other devices that will keep it from spreading.

If practical, a dam to contain the spill may be formed using coarse vermiculite, kitty litter, or another absorbent material.

Another inexpensive sorbent can be made from a mixture of sand and sodium carbonate. This is particularly effective with corrosives because the soda will neutralize acids, and the sand improves the footing and minimizes the possibility of slipping and falling into the spill. The use of sodium bicarbonate is also effective, and it will neutralize caustic spills.

11.4 Cleanup

If hazardous vapors are present, the area should be isolated. Only persons trained in the use of respirators may enter the area. This will frequently mean waiting for the arrival of the HAZMAT team.

Cleanup can proceed once the area is vented and the spill is contained. Mops, shovels, scoops, and buckets can be used in the usual manner.

Once the spill is thoroughly absorbed, the waste should be collected in heavy plastic bags, clearly labeled, and isolated for disposal.

After all hazardous material has been removed, cleanup can be completed using standard custodial cleaning procedures.

11.5 Protective Equipment

Protective equipment to be used in the cleanup process should include chemical splash goggles, face shields, heavy rubber gloves, coveralls or aprons or lab coats, and either rubber boots or plastic over-the-shoe protectors.

In no case should the cleanup of a major spill be undertaken by one not trained in these procedures. No one should work alone. The buddy system is essential to protect the workers. Further, the cleanup team should not begin work before contacting the Chemical Hygiene Officer or other appropriate authorities.

11.6 Training Requirements

To undertake the cleanup of a major or extremely hazardous spill, all responders should have Hazardous Waste Operations and Emergency Response (HAZWOPER) training. This training is available at various levels:

11.6.1 The "First Responder at the Awareness Level" must understand the nature of hazardous materials and the associated risks, recognize the presence of hazardous materials in an emergency, and understand the first responder's role in the College's emergency response plan, which is to determine risk, assist injured, evacuate, and call for assistance.

11.6.2 The "First Responder at the Operating Level" will know the basic hazard and risk-assessment techniques and terms, will select and use proper personal protective equipment, will perform basic control, containment, and/or confinement operations using the capabilities available within the school, will implement basic decontamination procedures, and will understand the relevant standard operating procedures and termination procedures.

11.6.3 "HAZWOPER Third-and Fourth-Level Response" will require a trained HAZMAT team, i.e., the fire department.

11.6.4 Training for all laboratory workers should include awareness level training which is reviewed on an annual basis. The second level, the operations response team, should have training sessions at least twice a year. If possible, this should be coordinated with local HAZMAT, fire department, or other emergency response teams to improve efficiency during an incident.

11.7 Disposal

If the spilled material was a hazardous chemical, all of the materials involved in the cleanup will usually be considered hazardous waste and must be disposed of as such.

In those few instances in which the cleanup transformed the material to a nonhazardous form, the cleanup residue may be disposed of in a local sanitary landfill. Check with local landfill authorities before attempting to do this.

11.8 Record-Keeping

Complete records of the incident, including injuries, witnesses, response and cleanup procedures, waste disposal, additional assistance, and final evaluation will be collected for the Department. Chemical Hygiene Officer and/or the Environmental Health and Safety Officer.

Appendix A

THE LABORATORY STANDARD

OSHA Laboratory Standard
29 CFR 1910.1450

PART 1910-OCCUPATIONAL SAFETY AND HEALTH STANDARDS

1. The authority citation for part 1910, subpart Z is amended by adding the following citation at the end. (Citation which precedes asterisk indicates general rulemaking authority.)

Authority: Secs. 6 and 8, Occupational Safety and Health Act, 29 U.S.C. 655, 657; Secretary of Labor's Orders Nos. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable; and 29 CFR part 1911.
* * * Section 1910.1450 is also issued under sec. 6(b), 8(c) and 8(g)(2), Pub.L. 91-596, 84 Stat. 1593, 1599, 1600; 29 U.S.C. 655, 657.

2. Section 1910.1450 is added to subpart Z, part 1910 to read as follows:

191.1450 Occupational exposure to hazardous chemicals in laboratories.

(a) *Scope and application.* (1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(2) Where the section applies it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

(i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

(ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

(iii) Where the action level (or in the absence of action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements, paragraphs (d0 and (g)(1)(ii) of this section shall apply.

(3) This section shall not apply to:

(i) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart 2, even if such occurs in a laboratory.

(ii) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(A) Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color chart supplied by the manufacturer of the test strip; and

(B) Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

(b) *Definitions*-

"Action level" means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Assistant Secretary" means the Assistant Secretary of labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Carcinogen" (see "select carcinogen").

"Chemical Hygiene Officer" means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitation on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

"Combustible liquid" means any liquid having a flashpoint at or above 100 °F (37.8 °C), but below 200 °F (93.3 °C), except any mixture having components with flashpoints of 200 °F (93.3 °C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Compressed Gas" means"

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 °F (21.1 °C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 °F (54.4 °C) regardless of the pressure at 70 °F (21.1 °C);or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 °F (37.8 °C) as determined by ASTM D-323-72.

"Designated Area" means an area which may be used for work with "select carcinogens" reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture or containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

"Employee" means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Flammable" means a chemical that falls into one of the following categories:

(i) "*Aerosol, flammable"* means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) *"Gas, flammable"* means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent b volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider that 12 percent by volume, regardless of the lower limit.

(iii) *"Liquid, flammable"* means any liquid having a flashpoint below 100 °F (37.8 °C), except any mixture having components with flashpoints of 100 °F (37.8 °C) or higher, the total of which make up 99 percent of more of the total volume of the mixture.

(iv) *"Solid, flammable"* means a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard for Flash Point by Tag Closed Tester, Z11.7-1979 (STM D93-79))-for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 °F (37.8 °C), than do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79))-for liquids with a

viscosity equal to or greater than 45SUS at 100 °F (37.8 °C), or that contain suspended solids, or that have a tendency to form a surface fulm under test; or

(iii)Setaflash Closed Tester (see American National standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Hazardous chemical" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hemtopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Appendices A and B of the Hazard Communication Standard (29CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

"Laboratory" means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

"Laboratory scale" means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

"*Laboratory-type hood"* means a device located in a laboratory, enclosure on five sides with a moveable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure with out insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use to that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

"Laboratory use of hazardous chemicals" means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii)Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

"Medical consultation" means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examination or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

"Organic peroxides" means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other that a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

"Reproductive toxins" means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)

"Select carcinogen" means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(iv) It is listed in either Group 2A or @B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3;

(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

"Unstable (reactive)" means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

(c) *Permissible exposure limits.* For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 26 CFR par 1910, subpart Z.

(d)*Employee exposure determination*-(1)*Initial monitoring.* The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL.

(2) *Periodic monitoring.* If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

(3) *Termination of monitoring.* Monitoring may be terminated in accordance with the relevant standard.

(4)*Employee notification of monitoring results.* The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

(e)*Chemical hygiene plan-General.* (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan). (1) Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

(i) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

(ii) Capable of keeping exposures below the limits specified in paragraph (c) of this section.

(2) The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

(3) The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

(i) Standard operating procedures relevant to safety and health considerations tob e followed when laboratory work involves the use of hazardous chemicals;

(ii) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular

attention shall be given to the selection of control measure for chemicals that are known to be extremely hazardous;

(iii) A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

(iv) Provisions for employee information and training as prescribed in paragraph (f) of this section;

(v) The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

(vi) Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

(vii) Designation of personnel responsible for implementation of Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer and, if appropriate, establishment of a Chemical Hygiene Committee; and

(viii) Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(A) Establishment of a designated area;

(B) Use of containment devices such as fume hood or glove boxes;

(C) Procedures for safe removal of contaminated waste; and

(D) Decontamination procedures.

(4) The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

(f) *Employee information and training.* (1) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(2) Such information shall be provided at the time of an employees' initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

(3) *Information.* Employees shall be informed of:

(i) The contents of this standard and its appendices which shall be made available to employees;

(ii) The location and availability of the employer's Chemical Hygiene Plan;

(iii) The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

(iv)Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(v) The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets received from the chemical supplier.

(4) *Training.* (I) Employee training shall include:

(A) Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(B) The physical and health hazards of chemicals in the work area; and

(C) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(g) *Medical consultation and medical examinations.* (1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(i) Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(ii) Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(iii) Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided and opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(2) All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(3) *Information provided to the physician.* The employer shall provide the following information to the physician:

(i) The identity of the hazardous chemical(s) to which the employee may have been exposed;

(ii) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(iii) A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(4) *Physician's written opinion.* (i) For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(A) Any recommendation for further medical follow-up;

(B) The results of the medical examination and any associated tests;

(C) Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and

(D) A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(ii) The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

(h) *Hazard identification.* (1) With respect to labels and material safety data sheets:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(2) The following provisions shall apply to chemical substances developed in the laboratory:

(i) If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

(ii) If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

(iii) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (26 CFR 1910.1200) including requirements for preparation of material safety data sheets and labeling.

(i) *Use of respirators.* Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

(j) *Recordkeeping.* (1) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any

medical consultation and examinations including test or written opinions required by this standard.

(2) The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20.

(k) *Dates*-(1) *Effective date.* This section shall become effective May 1, 1990.

(2) *Start-up dates.* (i) Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

(ii) Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

(l) *Appendices.* The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

Appendix A to 1910.1450-National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

Table of Contents

Foreword

As guidance for each employer's development of an appropriate laboratory Chemical Hygiene Plan, the following non-mandatory recommendations are provided. They were extracted from "Prudent Practices for handling Hazardous Chemical in Laboratories" (referred to below as "Prudent Practices"), which was published in 1981 by the National Research Council and is available from the National Academy Press, 2101 Constitution Ave., NW., Washington DC 20418.

"Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify any requirements of the laboratory standard. This Appendix merely presents pertinent recommendations from "Prudent Practices", organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a Chemical Hygiene Plan. Users of this appendix should consult "Prudent Practices" for a more extended presentation and justification for each recommendation.

"Prudent Practices" deals with both safety and chemical hazards while the laboratory standard is concerned primarily with chemical hazards. Therefore, only those recommendation directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical hygiene" being substituted for the word "safety". However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized, and headings have been added. However, their sense has not been changed.

Corresponding Sections of the Standard and this Appendix

The following table is given for the convenience of those who are developing a Chemical Hygiene Plan which will satisfy the requirements of paragraph (e) of the standard. It indicates those sections of this appendix which are most pertinent to each of the sections of paragraph (e) and related paragraphs.

Paragraph and topic in laboratory standard	Relevant appendix section
(e)(3)(i) Standard operating procedures for handling toxic chemicals.	C, D, E
(e)(3)(ii) Criteria to be used for implementation of measures to reduce exposure.	D
(e)(3)(iii) Fume hood performance	C4b
(e)(3)(iv) Employee information and training (including emergency procedures).	D10, D9
(e)(3)(v) Requirements for prior approval of laboratory activities.	E2b, E4b
(e)(3)(vi) Medical consultation and medical examinations	D5, E4f
(e)(3)(vii) Chemical hygiene responsibilities.	B
(e)(3)(viii) Special precautions for work with particularly hazardous substances.	E2, E3, E4

In this appendix, those recommendations directed primarily at administrators and supervisors are given in sections A-D. Those recommendations of primary concern to employees who are actually handling laboratory chemical are given in section E. (Reference to page numbers in "Prudent Practices" are given in parentheses.)

A. General Principles for Work with Laboratory Chemicals

In addition to the more detailed recommendations listed below in sections B-E, "Prudent Practices" expresses certain general principles, including the following:

1. *It is prudent to minimize all chemical exposures.* Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals (2, 10). Skin contact with chemicals should be avoided as a cardinal rule (198).

2. *Avoid underestimation of risk.* Even for substances of no known significant hazard, exposure should be minimized; for work with special precautions should be taken 910, 37, 38). One should

assume that any mixture will be more toxic than its most toxic component (30,103) and that all substances of unknown toxicity are toxic (3, 34).

3. *Provide adequate ventilation.* The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices (32, 198).

4. *Institute a chemical hygiene program.* A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity (6, 11). Its recommendations should be followed in academic teaching laboratories as ell as by full-time laboratory workers (13).

5. *Observe the PELs, TLVs*. The Permissible Exposure Limits of OSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded (13).

B. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rest at all levels (6, 11, 21) including the:

1. *Chief executive officer*, who has ultimate responsibility for chemical hygiene within the institution, and must with other administrators, provide continuing support for institutional chemical hygiene (7, 11).

2. *Supervisor of the department or other administrative unit*, who is responsible for chemical hygiene in that unit (7).

3. *Chemical hygiene officer(s),* whose appointment is essential (7) and who must:

(a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices (7);

(b) Monitor procurement, use, and disposal of chemicals used in the lab (8);

(c) See that appropriate audits are maintained (8);

(d) Help project directors develop precautions and adequate facilities (10);

(e) Know the current legal requirements concerning regulated substances (50); and

(f) Seek ways to improve the chemical hygiene program (8, 11).

4. *Laboratory supervisor*, who has overall responsibility for chemical hygiene in the laboratory (21) including responsibility to:

(a) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided (21, 22);

(b) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment (21, 171);

(c) Know the current legal requirements concerning regulated substances (50, 231);

(d) Determine the required levels of protective apparel and equipment (156, 160, 162); and

(e) ensure that facilities and training for use of any material being ordered are adequate (215).

5. *Project director or director of other specific operation,* who has primary responsibility for chemical hygiene procedures for that operation (7).

6. *Laboratory worker*, who is responsible for:

(a) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures (7, 21, 22, 230); and

(b) Developing good personal chemical hygiene habits (22).

C. The Laboratory Facility

1. *Design*. The laboratory facility should have:

(a) An appropriate general ventilation system (see C4 below) with air intakes and exhausts located so as to avoid intake of contaminated air (194);

(b) Adequate, well-ventilated stockrooms/storerooms (218, 219);

(c) Laboratory hoods and sinks (12, 162);

(d) Other safety equipment including eyewash fountains and drench showers (162, 169); and

(e) Arrangements for waste disposal (12, 240).

2. *Maintenance.* Chemical-hygiene-related equipment (hoods, incinerator, etc.) should undergo continuing appraisal and be modified if inadequate (11, 12).

3. *Usage.* The work conducted (10) and its scale (12) must be appropriate to the physical facilities available and, especially, to the quality of ventilation (13).

4. *Ventilation.*-(a) *General laboratory ventilation.* This system should: Provide a source of air for breathing and for input to local ventilation devices (199); it should not be relied on for protection from toxic substances released into the laboratory (198); ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day (194); direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building (194).

(b) *Hoods.* A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals (199); each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use (200, 209). If this is not possible, work with substances of unknown toxicity should be avoided (13) or other types of local ventilation devices should be provided (199). See pp. 201-206 for a discussion of hood design, construction, and evaluation.

(c) *Other local ventilation devices.* Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed (199). Each canopy hood and snorkel should have a separate duct (207).

(d) *Special ventilation areas.* Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system (208). Cold rooms and warm rooms should have provisions for rapid escape in the event of electrical failure (209).

(e) M*odifications.* Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate (12, 193, 204).

(f) *Performance.* Rate: 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control (194).

(g) Quality. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas (194,195); airflow into and within the hood should not be excessively turbulent (200); hood face velocity should be adequate (typically 60-100 lfm) (200, 204).

(h) *Evaluation.* Quality and quantity of ventilation should be evaluated on installation (202), regularly monitored (at least every 3 months) (6, 12, 14, 195), and reevaluated whenever a change in local ventilation devices is made (12, 195, 207). See pp. 195-198 for methods of evaluation and for calculation of estimated airborne contaminant concentrations.

D. Components of the chemical Hygiene Plan

1. Basic Rules and Procedures
(Recommendations for these are given in section E, below)

2. Chemical Procurement, Distribution, and Storage

(a) *Procurement*. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved (251, 216). No container should be accepted without an adequate identifying label (216).

(b) *Stockrooms/storerooms.* Toxic substances should be segregated in a well-identified area with local exhaust ventilation (221). Chemicals which are highly toxic (227) or other chemicals whose containers have been opened should be in unbreakable secondary containers (219). Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity (218-19).

Stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person (219).

(c) *Distribution.* When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible (223).

(d) *Laboratory storage.* Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom (225-6, 229).

3. Environmental Monitoring

Regular instrumental monitoring of airborne concentration is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devised (12) or when a highly toxic substance is stored or used regularly (e.g., 3 times/week) (13).

4. Housekeeping, Maintenance, and Inspections

(a) Cleaning. Floors should be cleaned regularly (24).

(b) Inspections. Formal housekeeping and chemical hygiene inspections should be held at least quarterly (6, 21) for units which have frequent personnel changes and semiannually for other; informal inspections should be continual (21).

(c) M*aintenance*. Eye wash fountains should be inspected at intervals of not less than 3 months (6). Respirators for routine use should be inspected periodically by the laboratory supervisor (169). Safety showers should be tested routinely (169). Other safety equipment should be inspected regularly. (e.g., every 3-6 months) (6, 24,171). Procedures to prevent restarting of out-of-service equipment should be established (25).

(d) *Passageways.* Stairways and hallways should not be used as storage areas (24). Access to exits, emergency equipment, and utility controls should never be blocked (24).

5. Medical Program

(a) *Compliance with regulations.* Regular medical surveillance should be established to the extent required by regulations (12).

(b) *Routine surveillance.* Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable (11, 50).

(c) *First aid.* Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby (173). See pp. 176-178 for description of some emergency first aid procedures.

6. Protective Apparel and Equipment

These should include for each laboratory:

(a) Protective apparel compatible with the required degree of protection for substance being handled (158-161);

(b) An easily accessible drench-type safety shower (162, 169);

(c) An eyewash fountain (162);

(d) A fire extinguisher (162-164);

(e) Respiratory protection (164-9), fire alarm and telephone for emergency use (162) should be available nearby; and

(f) Other items designated by the laboratory supervisor (156, 160).

7. Records

(a) Accident records should be written and retained (174).

(b) Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations (7).

(c) Inventory and usage records for high-risk substances should be kept as specified in sections E3e below.

(d) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations (12).

8. Signs and Labels

Prominent signs and labels of the following types should be posted:

(a) Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (28);

(b) Identity labels, showing contents of containers (including waste receptacles) and associated hazards (27, 48);

(c) Locations signs for safety showers, eyewash stations, other safety and first aid equipment, exits (27) and areas where food and beverage consumption and storage are permitted (24); and

(d) Warnings at areas or equipment where special or unusual hazards exist (27).

9. Spills and Accidents

(a) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure (200), evacuation, medical care, reporting, and drills (172).

(b) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms (172).

(c) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting (175).

(d) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit (8, 28).

10. Information and Training Program

(a) Aim: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs (5, 15).

(b) Emergency and Personal Protection Training: Every laboratory worker should know the location and proper use of available protective apparel and equipment (154, 169).

Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures (6).

Such training as well as first aid instruction should be available to (154) and encouraged for (176) everyone who might need it.

(c) Receiving and stockroom/storeroom personnel should know about hazards, handling equipment, protective apparel, and relevant regulations (217).

(d) Frequency of Training: The training and education program should be a regular, continuing activity-not simply an annual presentation (15).

(e) Literature/Consultation: Literature and consulting advice concerning chemical hygiene should be readily available to laboratory personnel, who should be encouraged to use these information resources (14).

11. Waste Disposal Program

(a) Aim: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals (5).

(b) Content (14,232, 233, 240): The waste disposal program should specify how waste is collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations (244).

(c) Discarding Chemical Stocks: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened (24, 270.

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage (226).

(d) Frequency of Disposal: Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals (14).

(e) Method of Disposal: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste (14, 238, 241).

Indiscriminate disposal by pouring waste chemicals down the drain (14, 231,242) or adding them to mixed refuse for landfill burial is unacceptable (14).

Hoods should not be used as a means of disposal for volatile chemical (40, 200).

Disposal by recycling (233, 243) or chemical decontamination should be used when possible.

E. Basic Rules and Procedures for Working with Chemicals

The Chemical Hygiene Plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the sub programs mentioned above, these should include the rules listed below.

1.General Rules

The following should be used for essentially all laboratory work with chemicals:

(a) *Accidents and spills*-eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention (33, 172).

Ingestion: Encourage the victim to drink large amounts of water (178).

Skin Contact: Promptly flush the affected area with water (33, 172, 178) and remove any contaminated clothing (172, 178). If symptoms persist after washing, seek medical attention (33).

Clean-up. Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal (24, 33). See pp. 233-237 for specific clean-up recommendations.

(b) *Avoidance of "routine" exposure;* Develop and encourage safe habits (230; avoid unnecessary exposure to chemicals by any route (23);

Do not smell or taste chemicals (32). Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices (199).

Inspect gloves (157) and test glove boxes (208) before use.

Do not allow release of toxic substances in cold rooms and worm rooms, since these have contained recirculated atmospheres (209).

(c) *Choice of chemicals:* Use only those chemicals for which the quality of the available ventilation system is appropriate (13).

(d) *Eating, smoking, etc.:* Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present (22, 24, 32, 40); wash hands before conducting these activities.

Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations (23, 24, 226).

(e)*Equipment and glassware:* handle and store laboratory glassware with care to avoid damage; do not use damaged glassware (250. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur (25). Use equipment only for its designed purpose (23, 26).

(f) *Exiting:* Wash areas of exposed skin well before leaving the laboratory (23).

(h) *Horseplay:* Avoid practical jokes or other behavior which might confuse, startle or distract another worker (23).

(i) *Personal apparel:* Confine long hair and loose clothing (23, 158). Wear shoes at all time in the laboratory but do not wear sandals, perforated shoes, or sneakers (158).

(j) *Personal housekeeping:* Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day (24).

(k) *Personal protection:* Assure that appropriate eye protection (154-156) is worn by all persons, including visitors, where chemicals are stored or handled (22, 23, 33, 154).

Wear appropriate gloves when the potential for contact with toxic materials exists (157); inspect the gloves before each use, wash them before removal, and replace them periodically (157). (A table of resistance to chemicals of common glove materials is given p. 159).

Use appropriate (164-168) respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls (164-5), inspecting the respirator before use (169).

Use any other protective and emergency apparel and equipment as appropriate (22, 157-162).

Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken (155).

Remove laboratory coats immediately on significant contamination (161).

(l) *Planning:* Seek information and advice about hazards (7), plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation (22, 23).

(m) *Unattended operations:* Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substance in the event of failure of a utility service (such as cooling water) to an unattended operation (27, 128).

(n) *Use of hood:* use the hood for operations which might result in release of toxic chemical vapors or dust (198-9).

As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less that 50 ppm (13).

Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made (200); keep materials stored in hoods to a minimum and do not allow them to block vents or air flow (200).

Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off" (200).

(o) *Vigilance:* Be alert to unsafe conditions and see that they are corrected when detected (22).

(p) *Waste disposal:* Assure that the plan for each laboratory operation includes plans and training for waste disposal (230).

Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan (22, 24).

Do not discharge to the sewer concentrated acids or bases (231); highly toxic, malodorous, or lachrymatory substances (231); or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow (242).

(q) *Working alone:* Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous (28).

2. Working with Allergens and Embryotoxins

(a) *Allergens* (examples: diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity (35).

(b) *Embryotoxins* (34-5) (examples: organomercurials, lead compounds, formamide): If you are a woman of childbearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.

Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

3. Work with Chemicals of Moderate Chronic or High Acute Toxicity

Examples: diisopropylfluorophosphate (41), hydrofluoric acid (43), hydrogen cyanide (45).

Supplemental rules to be followed in addition to those mention above (Procedure B of "Prudent Practices"' pp. 39-41):

(a) *Aim:* To minimize exposure to these toxic substances by any route using all reasonable precautions (39).

(b) *Applicability:* These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities (39).

(c) *Location:* use and store these substances only in areas of restricted access with special warning signs (40, 229).

Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) (40) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance (39); trap released vapors to prevent their discharge with the hood exhaust (40).

(d) *Personal protection:* Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate) (39). Always wash hands and arms immediately after working with these materials (40).

(e) *Records:* Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved (40, 229).

(f) *Prevention of spills and accidents:* Be prepared for accidents and spills (41).

Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity (39).

Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such tray or cover work and storage surfaces with removable, absorbent, plastic backed paper (40).

If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment (41).

(g) *Waste*: Thoroughly decontaminate or incinerate contaminated clothing or shoes (41). If possible, chemically decontaminate by chemical conversion (40).

Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite) (40).

4. Work with chemicals of High Chronic Toxicity

(Examples: dimethylmercury and nickel carbonyl (48), benzo-a-pyrene (51), N-nitrosodiethylamine (54), other human carcinogens or substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) (47). (Procedure A of "Prudent Practices" pp. 47-50).

(a) *Access*: Conduct all transfers and work with these substances in a "controlled area": a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substance being used and necessary precautions (48).

(b) *Approvals:* Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor (48).

(c) *Non-contamination/Decontamination*: protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood (49). Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area (49, 50).

Decontaminate the controlled area before normal work is resumed there (50).

(d) *Exiting:* On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck (49).

(e) *Housekeeping*: Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder (50).

(f) *Medical surveillance:* If using toxicologically significant quantities of such a substance on a regular basis (*e.g.*, 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance (50).

(g) *Records:* Keep accurate records of the amounts of these substances stored (229) and used, the dates of use, and names of users (48).

(h) *Signs and labels:* Assure that the controlled area is conspicuously marked with warning and restricted access signs (49) and that all containers of these substances are appropriately labeled with identity and warning labels (48).

(i) *Spills:* Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available (233-4).

(j) *Storage:* Store containers of these chemicals only in a ventilated, limited access (48, 227, 229) area in appropriately labeled, unbreakable, chemically resistant, secondary containers (48, 229).

(k) G*love boxes*: For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (48). For a positive pressure glove box, thoroughly check for leaks before each use (49). In either case, trap exit gases of filter them through a HEPA filter and then release them into the hood (49).

(l) *Waste:* Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel (49, 50, 233).

5. Animal Work with Chemicals of High Chronic Toxicity

(a) *Access:* For large scale studies, special facilities with restricted access are preferable (56).

(b) *Administration of the toxic substance:* When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters (56).

(c) *Aerosol suppression:* Devise procedures which minimize formation and dispersal of contaminated aerosols, including those form food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood) (55, 56).

(d) *Personal protection:* When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator) (56).

(e) *Waste disposal:* Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products (238); otherwise package the waste appropriately for burial in an EPA-approved site (239).

F. Safety Recommendations

The above recommendations from "Prudent Practices" do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene:

1. Corrosive agents: (35-6)
2. Electrically powered laboratory apparatus: (179-92)
3. Fires, explosions: (26, 57-74, 162-4, 174-5,219-20, 226-7)
4. Low temperature procedures: (26, 88)
5. Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101)

G. Material Safety Data Sheets

Material safety data sheets are presented in "Prudent Practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided).

*Acetyl peroxide (105)
*Acrolein (106)
*Acrylonilrile (107)
Ammonia (anhydrous) (91)
*Aniline (109)
*Benzene (110)
*Benzo[a]pyrene (112)
*Bis(chloromethyl) ether (113)
Boron trichloride (91)
Boron trifluoride (92)
Bromine (114)
*Tert-butyl hydroperoxide (148)
*Carbon disulfide (116)
Carbon monoxide (92)
*Carbon tetrachloride (118)
*Chlorine (119)
Chlorine trifluoride (94)
*Chloroform (121)
Chloromethane (93)
*Diethyl ether (122)
Diisopropyl fluorophosphate (41)
*Dimehylformamide (123)
*Dimethyl sulfate (125)
*Dioxane (126)
*Ethylene dibromide (128)
*Fluorine (95)
*Formaldehyde (130)
*Hydrazine and salts (132)
Hydrofluoric acid (43)
Hydrogen bromide (98)
Hydrogen chloride (98)
*Hydrogen sulfide (135)
Mercury and compounds (52)
*Methanol (137)
*Morpholine (138)
*Nickel carbonyl (99)
*Nitrobenzene (139)
Nitrogen dioxide (100)
N-nitrosodiethylamine (54)
*Peracetic acid (141)
*Phenol (142)
*Phosgene (143)
*Pyridine (144)
*Sodium azide (145)

*Sodium cyanide (147)
Sulfur dioxide (101)
*Trichloroethylene (149)
*Vinyl chloride (150)

Appendix B to 1910.1450-References (Non-Mandatory)

The following references are provided to assist the employer in the development of a Chemical Hygiene Plan. The materials listed below are offered as non-mandatory guidance. References listed here do no imply specific endorsement of a book, opinion, technique, policy or a specific solution for a safety or health problem. Other references not listed here may better meet the needs of a specific laboratory. (a) Materials for the development of the Chemical Hygiene Plan:

1. American Chemical Society, Safety in the Academic Chemistry Laboratories, 4th edition, 1985.
2. Fawcett, H.H. and W.S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd edition, Wiley-Interscience, New York, 1982.
3. Flury, Patricia A., Environmental Health and Safety in the Hospital Laboratory, Charles C. Thomas Publisher, Springfield IL., 1978.
4. Green, Michael E. and Turk, Amos, Safety in Working with Chemicals, Macmillan Publishing co., NY, 1978.
5. Kaufman, James a., Laboratory Safety Guidelines, Dow Chemical Co., Box 1713, Midland MI 48640, 1977.
6. National Institutes of Health, NIH Guidelines for the Laboratory use of Chemical Carcinogens, NIH Pub. No. 81-2385, GPO Washington, DC 20402, 1981.
7. National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington DC, 1983.
8. National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington DC, 1981.
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3. Best Company, Best Safety Directory, Vols. I and II, Oldwick, N.J., 1981.
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6. Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Govt. Printing Office, Washingotn, DC 20402 (latest edition).
7. IARC Monographs on the Evaluation of the carcinogenic Risk of Chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest editions).
8. NIOSH/OSHA pocket Guide to Chemical hazards, NIOSH Pub. No. 85-11, U.s. Government Printing Office, Washington, DC, 1985 (or latest edition).
9. Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123 U.S. Government Publishing Office, Washington, DC, 1981.
10. Patty, F.F., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, NY (five Volumes).
11. Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402.
12. The Merck Index: An Encyclopedia of Chemicals and Drugs, Merck and Company Inc., Rahway, N.J., 1976 (or latest edition).
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14. Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, NJ, 1981.

(c) Information of Ventilation:

1. American Conference of Governmental Industrial Hygienists Industrial Ventilation, 16th edition Lansing, MI, 1980.
2. American National Standards Institute, Inc. American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems ANSI Z 9.2-1979 American National Standards Institute, N.Y., 1979.
3. Imad, A.P. and Watson, C.L. Ventilation Index: An Easy Way to Decide about Hazardous Liquids, Professional Safety pp 15-18, April 1980.
4. National Fire Protection Association, Fire Protection for Laboratories Using Chemicals NFPA-45, 1982.

Safety Standard for Laboratories in Health Related Institutions, NFPA, 56c, 1980.

Fire Protection Guide on Hazardous Materials, 7th edition, 1978.

National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

5. Scientific Apparatus Makers Association (SAMA), Standard for Laboratory Fume Hoods, SAMA LF-71980, 1101 16th Street, NW., Washington, C 20036.

(d) Information on Availability of Referenced Material:

1. American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.
2. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.

(Approved by the Office of Management and Budget under control number 1218-0131)
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Appendix B

COMPRESSED GASES

(4) *Scope.* This section applies to all radiations originating from radio stations, radar equipment, and other possible sources of electromagnetic radiation such as used for communication, radio navigation, and industrial and scientific purposes. This section does not apply to the deliberate exposure of patients by, or under the direction of, practitioners of the healing arts.

(b) [Reserved]

[39 FR 23502, June 27, 1974, as amended at 61 FR 9236, Mar. 7, 1996]

§ 1910.98 Effective dates.

(a) The provisions of this Subpart G shall become effective on August 27, 1971, except as provided in the remaining paragraphs of this section.

(b) The following provisions shall become effective on February 15, 1972:

§ 1910.94 (a)(2)(iii), (a)(3), (a)(4), (b), (c)(2), (c)(3), (c)(4), (c)(5), (c)(6)(i), (c)(6)(ii), (d)(1)(ii), (d)(3), (d)(4), (d)(5), and (d)(7).

(c) Notwithstanding anything in paragraph (a), (b), or (d) of this section, any provision in any other section of this subpart which contains in itself a specific effective date or time limitation shall become effective on such date or shall apply in accordance with such limitation.

(d) Notwithstanding anything in paragraph (a) of this section, if any standard in 41 CFR part 50–204, other than a national consensus standard incorporated by reference in § 50–204.2(a)(1), is or becomes applicable at any time to any employment and place of employment, by virtue of the Walsh-Healey Public Contracts Act, or the Service Contract Act of 1965, or the National Foundation on Arts and Humanities Act of 1965, any corresponding established Federal standard in this Subpart G which is derived from 41 CFR part 50–204 shall also become effective, and shall be applicable to such employment and place of employment, on the same date.

Subpart H—Hazardous Materials

AUTHORITY: Sections 4, 6, and 8 of the Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Orders Nos. 12–71 (36 FR 8754), 8–76 (41 FR 25059), 9–83 (48 FR 35736), 1–90 (55 FR 9033), 6–96 (62 FR 111), 3–2000 (65 FR 50017), or 5–2002 (67 FR 65008), as applicable; and 29 CFR part 1911.

Sections 1910.103, 1910.106 through 1910.111, and 1910.119, 1910.120, and 1910.122 through 126 also issued under 29 CFR part 1911.

Section 1910.119 also issued under section 304, Clean Air Act Amendments of 1990 (Pub. L. 101–549), reprinted at 29 U.S.C. 655 Note.

Section 1910.120 also issued under section 126, Superfund Amendments and Reauthorization Act of 1986 as amended (29 U.S.C. 655 Note), and 5 U.S.C. 553.

§ 1910.101 Compressed gases (general requirements).

(a) *Inspection of compressed gas cylinders.* Each employer shall determine that compressed gas cylinders under his control are in a safe condition to the extent that this can be determined by visual inspection. Visual and other inspections shall be conducted as prescribed in the Hazardous Materials Regulations of the Department of Transportation (49 CFR parts 171–179 and 14 CFR part 103). Where those regulations are not applicable, visual and other inspections shall be conducted in accordance with Compressed Gas Association Pamphlets C–6–1968 and C–8–1962, which is incorporated by reference as specified in § 1910.6.

(b) *Compressed gases.* The in-plant handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tankcars, or motor vehicle cargo tanks shall be in accordance with Compressed Gas Association Pamphlet P–1–1965, which is incorporated by reference as specified in § 1910.6.

(c) *Safety relief devices for compressed gas containers.* Compressed gas cylinders, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with Compressed Gas Association Pamphlets S–1.1–1963 and 1965 addenda and S–1.2–1963, which is incorporated by reference as specified in § 1910.6.

[39 FR 23502, June 27, 1974, as amended at 61 FR 9236, Mar. 7, 1996]

§ 1910.102 Acetylene.

(a) *Cylinders.* The in-plant transfer, handling, storage, and utilization of acetylene in cylinders shall be in accordance with Compressed Gas Association Pamphlet G–1–1966, which is incorporated by reference as specified in § 1910.6.

(b) *Piped systems.* The piped systems for the inplant transfer and distribution of acetylene shall be designed, installed, maintained, and operated in accordance with Compressed Gas Association Pamphlet G–1.3–1959, which is incorporated by reference as specified in §1910.6.

(c) *Generators and filling cylinders.* Plants for the generation of acetylene and the charging (filling) of acetylene cylinders shall be designed, constructed, and tested in accordance with the standards prescribed in Compressed Gas Association Pamphlet G–1.4–1966, which is incorporated by reference as specified in §1910.6.

[39 FR 23502, June 27, 1974, as amended at 61 FR 9236, Mar. 7, 1996]

§1910.103 Hydrogen.

(a) *General*—(1) *Definitions.* As used in this section (i) Gaseous hydrogen system is one in which the hydrogen is delivered, stored and discharged in the gaseous form to consumer's piping. The system includes stationary or movable containers, pressure regulators, safety relief devices, manifolds, interconnecting piping and controls. The system terminates at the point where hydrogen at service pressure first enters the consumer's distribution piping.

(ii) Approved—Means, unless otherwise indicated, listed or approved by a nationally recognized testing laboratory. Refer to §1910.7 for definition of nationally recognized testing laboratory.

(iii) Listed—See ''approved''.

(iv) ASME—American Society of Mechanical Engineers.

(v) DOT Specifications—Regulations of the Department of Transportation published in 49 CFR Chapter I.

(vi) DOT regulations—See §1910.103 (a)(1)(v).

(2) *Scope*—(i) *Gaseous hydrogen systems.* (*a*) Paragraph (b) of this section applies to the installation of gaseous hydrogen systems on consumer premises where the hydrogen supply to the consumer premises originates outside the consumer premises and is delivered by mobile equipment.

(*b*) Paragraph (b) of this section does not apply to gaseous hydrogen systems having a total hydrogen content of less than 400 cubic feet, nor to hydrogen manufacturing plants or other establishments operated by the hydrogen supplier or his agent for the purpose of storing hydrogen and refilling portable containers, trailers, mobile supply trucks, or tank cars.

(ii) *Liquefied hydrogen systems.* (*a*) Paragraph (c) of this section applies to the installation of liquefied hydrogen systems on consumer premises.

(*b*) Paragraph (c) of this section does not apply to liquefied hydrogen portable containers of less than 150 liters (39.63 gallons) capacity; nor to liquefied hydrogen manufacturing plants or other establishments operated by the hydrogen supplier or his agent for the sole purpose of storing liquefied hydrogen and refilling portable containers, trailers, mobile supply trucks, or tank cars.

(b) *Gaseous hydrogen systems*—(1) *Design*—(i) *Containers.* (*a*) Hydrogen containers shall comply with one of the following:

(*1*) Designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Section VIII—Unfired Pressure Vessels—1968, which is incorporated by reference as specified in §1910.6.

(*2*) Designed, constructed, tested and maintained in accordance with U.S. Department of Transportation Specifications and Regulations.

(*b*) Permanently installed containers shall be provided with substantial noncombustible supports on firm noncombustible foundations.

(*c*) Each portable container shall be legibly marked with the name ''Hydrogen'' in accordance with ''Marking Portable Compressed Gas Containers to Identify the Material Contained'' ANSI Z48.1—1954, which is incorporated by reference as specified in §1910.6. Each manifolded hydrogen supply unit shall be legibly marked with the name Hydrogen or a legend such as ''This unit contains hydrogen.''

(ii) *Safety relief devices.* (*a*) Hydrogen containers shall be equipped with safety relief devices as required by the ASME Boiler and Pressure Vessel Code, Section VIII Unfired Pressure Vessels, 1968 or the DOT Specifications and

Regulations under which the container is fabricated.

(*b*) Safety relief devices shall be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container, adjacent structure or personnel. This requirement does not apply to DOT Specification containers having an internal volume of 2 cubic feet or less.

(*c*) Safety relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device.

(iii) *Piping, tubing, and fittings.* (*a*) Piping, tubing, and fittings shall be suitable for hydrogen service and for the pressures and temperatures involved. Cast iron pipe and fittings shall not be used.

(*b*) Piping and tubing shall conform to Section 2—''Industrial Gas and Air Piping''—Code for Pressure Piping, ANSI B31.1–1967 with addenda B31.1–1969, which is incorporated by reference as specified in § 1910.6.

(*c*) Joints in piping and tubing may be made by welding or brazing or by use of flanged, threaded, socket, or compression fittings. Gaskets and thread sealants shall be suitable for hydrogen service.

(iv) *Equipment assembly.* (*a*) Valves, gauges, regulators, and other accessories shall be suitable for hydrogen service.

(*b*) Installation of hydrogen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use.

(*c*) Storage containers, piping, valves, regulating equipment, and other accessories shall be readily accessible, and shall be protected against physical damage and against tampering.

(*d*) Cabinets or housings containing hydrogen control or operating equipment shall be adequately ventilated.

(*e*) Each mobile hydrogen supply unit used as part of a hydrogen system shall be adequately secured to prevent movement.

(*f*) Mobile hydrogen supply units shall be electrically bonded to the system before discharging hydrogen.

(v) *Marking.* The hydrogen storage location shall be permanently placarded as follows: ''HYDROGEN—FLAMMABLE GAS—NO SMOKING—NO OPEN FLAMES,'' or equivalent.

(vi) *Testing.* After installations, all piping, tubing, and fittings shall be tested and proved hydrogen gas tight at maximum operating pressure.

(2) *Location*—(i) *General.* (*a*) The system shall be located so that it is readily accessible to delivery equipment and to authorized personnel.

(*b*) Systems shall be located above ground.

(*c*) Systems shall not be located beneath electric power lines.

(*d*) Systems shall not be located close to flammable liquid piping or piping of other flammable gases.

(*e*) Systems near aboveground flammable liquid storage shall be located on ground higher than the flammable liquid storage except when dikes, diversion curbs, grading, or separating solid walls are used to prevent accumulation of flammable liquids under the system.

(ii) *Specific requirements.* (*a*) The location of a system, as determined by the maximum total contained volume of hydrogen, shall be in the order of preference as indicated by Roman numerals in Table H–1.

TABLE H–1

Nature of location	Size of hydrogen system		
	Less than 3,000 CF	3,000 CF to 15,000 CF	In excess of 15,000 CF
Outdoors	I	IDI..	
In a separate building	II	II	II.
In a special room	III	III	Not permitted.
Inside buildings not in a special room and exposed to other occupancies.	IV	Not permitted.	Not permitted.

(*b*) The minimum distance in feet from a hydrogen system of indicated capacity located outdoors, in separate buildings or in special rooms to any specified outdoor exposure shall be in accordance with Table H–2.

(*c*) The distances in Table H–2 Items 1 and 3 to 10 inclusive do not apply where protective structures such as adequate fire walls are located between the system and the exposure.

TABLE H–2

Type of outdoor exposure		Size of hydrogen system		
		Less than 3,000 CF	3,000 CF to 15,000 CF	In excess of 15,000 CF
1. Building or structure	Wood frame construction[1]	10	25	50
	Heavy timber, noncombustible or ordinary construction[1].	0	10	[2]25
	Fire-resistive construction[1]	0	0	0
2. Wall openings	Not above any part of a system	10	10	10
	Above any part of a system	25	25	25
3. Flammable liquids above ground.	0 to 1,000 gallons	10	25	25
	In excess of 1,000 gallons	25	50	50
4. Flammable liquids below ground—0 to 1,000 gallons.	Tank	10	10	10
	Vent or fill opening of tank	25	25	25
5. Flammable liquids below ground—in excess of 1,000 gallons..	Tank	20	20	20
	Vent or fill opening of tank	25	25	25
6. Flammable gas storage, either high pressure or low pressure..	0 to 15,000 CF capacity	10	25	25
	In excess of 15,000 CF capacity	25	50	50
7. Oxygen storage	12,000 CF or less[4]	.....	.....	.....
	More than 12,000 CF[5]	.....	.....	.....
8. Fast burning solids such as ordinary lumber, excelsior or paper		50	50	50
9. Slow burning solids such as heavy timber or coal		25	25	25
10. Open flames and other sources of ignition		25	25	25
11. Air compressor intakes or inlets to ventilating or air-conditioning equipment		50	50	50
12. Concentration of people[3]		25	50	50

[1] Refer to NFPA No. 220 Standard Types of Building Construction for definitions of various types of construction. (1969 Ed.)
[2] But not less than one-half the height of adjacent side wall of the structure.
[3] In congested areas such as offices, lunchrooms, locker rooms, time-clock areas.
[4] Refer to NFPA No. 51, gas systems for welding and cutting (1969).
[5] Refer to NFPA No. 566, bulk oxygen systems at consumer sites (1969).

(*d*) Hydrogen systems of less than 3,000 CF when located inside buildings and exposed to other occupancies shall be situated in the building so that the system will be as follows:

(*1*) In an adequately ventilated area as in paragraph (b)(3)(ii)(*b*) of this section.

(*2*) Twenty feet from stored flammable materials or oxidizing gases.

(*3*) Twenty-five feet from open flames, ordinary electrical equipment or other sources of ignition.

(*4*) Twenty-five feet from concentrations of people.

(*5*) Fifty feet from intakes of ventilation or air-conditioning equipment and air compressors.

(*6*) Fifty feet from other flammable gas storage.

(*7*) Protected against damage or injury due to falling objects or working activity in the area.

(*8*) More than one system of 3,000 CF or less may be installed in the same room, provided the systems are separated by at least 50 feet. Each such system shall meet all of the requirements of this paragraph.

(3) *Design consideration at specific locations*—(i) *Outdoor locations.* (*a*) Where protective walls or roofs are provided, they shall be constructed of noncombustible materials.

(*b*) Where the enclosing sides adjoin each other, the area shall be properly ventilated.

(*c*) Electrical equipment within 15 feet shall be in accordance with subpart S of this part.

(ii) *Separate buildings.* (*a*) Separate buildings shall be built of at least noncombustible construction. Windows and doors shall be located so as to be readily accessible in case of emergency. Windows shall be of glass or plastic in metal frames.

(*b*) Adequate ventilation to the outdoors shall be provided. Inlet openings shall be located near the floor in exterior walls only. Outlet openings shall be located at the high point of the room in exterior walls or roof. Inlet and outlet openings shall each have minimum total area of one (1) square foot per 1,000 cubic feet of room volume. Discharge from outlet openings shall be directed or conducted to a safe location.

(*c*) Explosion venting shall be provided in exterior walls or roof only. The venting area shall be equal to not

less than 1 square foot per 30 cubic feet of room volume and may consist of any one or any combination of the following: Walls of light, noncombustible material, preferably single thickness, single strength glass; lightly fastened hatch covers; lightly fastened swinging doors in exterior walls opening outward; lightly fastened walls or roof designed to relieve at a maximum pressure of 25 pounds per square foot.

(*d*) There shall be no sources of ignition from open flames, electrical equipment, or heating equipment.

(*e*) Electrical equipment shall be in accordance with subpart S of this part for Class I, Division 2 locations.

(*f*) Heating, if provided, shall be by steam, hot water, or other indirect means.

(iii) *Special rooms.* (*a*) Floor, walls, and ceiling shall have a fire-resistance rating of at least 2 hours. Walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall shall be an exterior wall. Openings to other parts of the building shall not be permitted. Windows and doors shall be in exterior walls and shall be located so as to be readily accessible in case of emergency. Windows shall be of glass or plastic in metal frames.

(*b*) Ventilation shall be as provided in paragraph (b)(3)(ii)(*b*) of this section.

(*c*) Explosion venting shall be as provided in paragraph (b)(3)(ii)(*c*) of this section.

(*d*) There shall be no sources of ignition from open flames, electrical equipment, or heating equipment.

(*e*) Electric equipment shall be in accordance with the requirements of subpart S of this part for Class I, Division 2 locations.

(*f*) Heating, if provided, shall be by steam, hot water, or indirect means.

(4) *Operating instructions.* For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations.

(5) *Maintenance.* The equipment and functioning of each charged gaseous hydrogen system shall be maintained in a safe operating condition in accordance with the requirements of this section. The area within 15 feet of any hydrogen container shall be kept free of dry vegetation and combustible material.

(c) *Liquefied hydrogen systems*—(1) *Design*—(i) *Containers.* (*a*) Hydrogen containers shall comply with the following: Storage containers shall be designed, constructed, and tested in accordance with appropriate requirements of the ASME Boiler and Pressure Vessel Code, Section VIII—Unfired Pressure Vessels (1968) or applicable provisions of API Standard 620, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Second Edition (June 1963) and appendix R (April 1965), which is incorporated by reference as specified in § 1910.6.

(*b*) Portable containers shall be designed, constructed and tested in accordance with DOT Specifications and Regulations.

(ii) *Supports.* Permanently installed containers shall be provided with substantial noncombustible supports securely anchored on firm noncombustible foundations. Steel supports in excess of 18 inches in height shall be protected with a protective coating having a 2-hour fire-resistance rating.

(iii) *Marking.* Each container shall be legibly marked to indicate ''LIQUEFIED HYDROGEN—FLAMMABLE GAS.''

(iv) *Safety relief devices.* (*a*)(*1*) Stationary liquefied hydrogen containers shall be equipped with safety relief devices sized in accordance with CGA Pamphlet S–1, Part 3, Safety Relief Device Standards for Compressed Gas Storage Containers, which is incorporated by reference as specified in § 1910.6.

(*2*) Portable liquefied hydrogen containers complying with the U.S. Department of Transportation Regulations shall be equipped with safety relief devices as required in the U.S. Department of Transportation Specifications and Regulations. Safety relief devices shall be sized in accordance with the requirements of CGA Pamphlet S–1, Safety Relief Device Standards, Part 1, Compressed Gas Cylinders and Part 2, Cargo and Portable Tank Containers.

(*b*) Safety relief devices shall be arranged to discharge unobstructed to the outdoors and in such a manner as to prevent impingement of escaping

liquid or gas upon the container, adjacent structures or personnel. See paragraph (c)(2)(i)(*f*) of this section for venting of safety relief devices in special locations.

(*c*) Safety relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device.

(*d*) Safety relief devices shall be provided in piping wherever liquefied hydrogen could be trapped between closures.

(v) *Piping, tubing, and fittings.* (*a*) Piping, tubing, and fittings and gasket and thread sealants shall be suitable for hydrogen service at the pressures and temperatures involved. Consideration shall be given to the thermal expansion and contraction of piping systems when exposed to temperature fluctuations of ambient to liquefied hydrogen temperatures.

(*b*) Gaseous hydrogen piping and tubing (above −20 °F.) shall conform to the applicable sections of Pressure Piping Section 2—Industrial Gas and Air Piping, ANSI B31.1–1967 with addenda B31.1–1969. Design of liquefied hydrogen or cold (−20 °F. or below) gas piping shall use Petroleum Refinery Piping ANSI B31.3–1966 or Refrigeration Piping ANSI B31.5–1966 with addenda B31.5a–1968 as a guide, which are incorporated by reference as specified in §1910.6.

(*c*) Joints in piping and tubing shall preferably be made by welding or brazing; flanged, threaded, socket, or suitable compression fittings may be used.

(*d*) Means shall be provided to minimize exposure of personnel to piping operating at low temperatures and to prevent air condensate from contacting piping, structural members, and surfaces not suitable for cryogenic temperatures. Only those insulating materials which are rated nonburning in accordance with ASTM Procedures D1692–68, which is incorporated by reference as specified in §1910.6, may be used. Other protective means may be used to protect personnel. The insulation shall be designed to have a vapor-tight seal in the outer covering to prevent the condensation of air and subsequent oxygen enrichment within the insulation. The insulation material and outside shield shall also be of adequate design to prevent attrition of the insulation due to normal operating conditions.

(*e*) Uninsulated piping and equipment which operate at liquefied-hydrogen temperature shall not be installed above asphalt surfaces or other combustible materials in order to prevent contact of liquid air with such materials. Drip pans may be installed under uninsulated piping and equipment to retain and vaporize condensed liquid air.

(vi) *Equipment assembly.* (*a*) Valves, gauges, regulators, and other accessories shall be suitable for liquefied hydrogen service and for the pressures and temperatures involved.

(*b*) Installation of liquefied hydrogen systems shall be supervised by personnel familiar with proper practices and with reference to their construction and use.

(*c*) Storage containers, piping, valves, regulating equipment, and other accessories shall be readily accessible and shall be protected against physical damage and against tampering. A shutoff valve shall be located in liquid product withdrawal lines as close to the container as practical. On containers of over 2,000 gallons capacity, this shutoff valve shall be of the remote control type with no connections, flanges, or other appurtenances (other than a welded manual shutoff valve) allowed in the piping between the shutoff valve and its connection to the inner container.

(*d*) Cabinets or housings containing hydrogen control equipment shall be ventilated to prevent any accumulation of hydrogen gas.

(vii) *Testing.* (*a*) After installation, all field-erected piping shall be tested and proved hydrogen gas-tight at operating pressure and temperature.

(*b*) Containers if out of service in excess of 1 year shall be inspected and tested as outlined in (*a*) of this subdivision. The safety relief devices shall be checked to determine if they are operable and properly set.

(viii) *Liquefied hydrogen vaporizers.* (*a*) The vaporizer shall be anchored and its connecting piping shall be sufficiently flexible to provide for the effect of expansion and contraction due to temperature changes.

(*b*) The vaporizer and its piping shall be adequately protected on the hydrogen and heating media sections with safety relief devices.

(*c*) Heat used in a liquefied hydrogen vaporizer shall be indirectly supplied utilizing media such as air, steam, water, or water solutions.

(*d*) A low temperature shutoff switch shall be provided in the vaporizer discharge piping to prevent flow of liquefied hydrogen in the event of the loss of the heat source.

(ix) *Electrical systems.* (*a*) Electrical wiring and equipment located within 3 feet of a point where connections are regularly made and disconnected, shall be in accordance with subpart S of this part, for Class I, Group B, Division 1 locations.

(*b*) Except as provided in (*a*) of this subdivision, electrical wiring, and equipment located within 25 feet of a point where connections are regularly made and disconnected or within 25 feet of a liquid hydrogen storage container, shall be in accordance with subpart S of this part, for Class I, Group B, Division 2 locations. When equipment approved for class I, group B atmospheres is not commercially available, the equipment may be—

(*1*) Purged or ventilated in accordance with NFPA No. 496–1967, Standard for Purged Enclosures for Electrical Equipment in Hazardous Locations,

(*2*) Intrinsically safe, or

(*3*) Approved for Class I, Group C atmospheres. This requirement does not apply to electrical equipment which is installed on mobile supply trucks or tank cars from which the storage container is filled.

(x) *Bonding and grounding.* The liquefied hydrogen container and associated piping shall be electrically bonded and grounded.

(2) *Location of liquefied hydrogen storage*—(i) *General requirements.* (*a*) The storage containers shall be located so that they are readily accessible to mobile supply equipment at ground level and to authorized personnel.

(*b*) The containers shall not be exposed by electric power lines, flammable liquid lines, flammable gas lines, or lines carrying oxidizing materials.

(*c*) When locating liquified hydrogen storage containers near above-ground flammable liquid storage or liquid oxygen storage, it is advisable to locate the liquefied hydrogen container on ground higher than flammable liquid storage or liquid oxygen storage.

(*d*) Where it is necessary to locate the liquefied hydrogen container on ground that is level with or lower than adjacent flammable liquid storage or liquid oxygen storage, suitable protective means shall be taken (such as by diking, diversion curbs, grading), with respect to the adjacent flammable liquid storage or liquid oxygen storage, to prevent accumulation of liquids within 50 feet of the liquefied hydrogen container.

(*e*) Storage sites shall be fenced and posted to prevent entrance by unauthorized personnel. Sites shall also be placarded as follows: ''Liquefied Hydrogen—Flammable Gas—No Smoking—No Open Flames.''

(*f*) If liquified hydrogen is located in (as specified in Table H–3) a separate building, in a special room, or inside buildings when not in a special room and exposed to other occupancies, containers shall have the safety relief devices vented unobstructed to the outdoors at a minimum elevation of 25 feet above grade to a safe location as required in paragraph (c)(1)(iv)(*b*) of this section.

(ii) *Specific requirements.* (*a*) The location of liquefied hydrogen storage, as determined by the maximum total quantity of liquified hydrogen, shall be in the order of preference as indicated by Roman numerals in the following Table H–3.

TABLE H–3—MAXIMUM TOTAL QUANTITY OF LIQUEFIED HYDROGEN STORAGE PERMITTED

Nature of location	Size of hydrogen storage (capacity in gallons)			
	39.63 (150 liters) to 50	51 to 300	301 to 600	In excess of 600
Outdoors	I	I	I	I.
In a separate building	II	II	II	Not permitted.
In a special room	III	III	Not permitted	Do.

TABLE H–3—MAXIMUM TOTAL QUANTITY OF LIQUEFIED HYDROGEN STORAGE PERMITTED—Continued

Nature of location	Size of hydrogen storage (capacity in gallons)			
	39.63 (150 liters) to 50	51 to 300	301 to 600	In excess of 600
Inside buildings not in a special room and exposed to other occupancies.	IV	Not permitted	.....do	Do.

NOTE: This table does not apply to the storage in dewars of the type generally used in laboratories for experimental purposes.

(*b*) The minimum distance in feet from liquefied hydrogen systems of indicated storage capacity located outdoors, in a separate building, or in a special room to any specified exposure shall be in accordance with Table H–4.

TABLE H–4—MINIMUM DISTANCE (FEET) FROM LIQUEFIED HYDROGEN SYSTEMS TO EXPOSURE [1,2]

Type of exposure	Liquefied hydrogen storage (capacity in gallons)		
	39.63 (150 liters) to 3,500	3,501 to 15,000	15,001 to 30,000
1. Fire-resistive building and fire walls [3]	5	5	5
2. Noncombustible building [3]	25	50	75
3. Other buildings [3]	50	75	100
4. Wall openings, air-compressor intakes, inlets for air-conditioning or ventilating equipment	75	75	75
5. Flammable liquids (above ground and vent or fill openings if below ground) (see 513 and 514)	50	75	100
6. Between stationary liquefied hydrogen containers	5	5	5
7. Flammable gas storage ..	50	75	100
8. Liquid oxygen storage and other oxidizers (see 513 and 514)	100	100	100
9. Combustible solids	50	75	100
10. Open flames, smoking and welding	50	50	50
11. Concentrations of people	75	75	75

[1] The distance in Nos. 2, 3, 5, 7, 9, and 12 in Table H–4 may be reduced where protective structures, such as firewalls equal to height of top of the container, to safeguard the liquefied hydrogen storage system, are located between the liquefied hydrogen storage installation and the exposure.

[2] Where protective structures are provided, ventilation and confinement of product should be considered. The 5-foot distance in Nos. 1 and 6 facilitates maintenance and enhances ventilation.

[3] Refer to Standard Types of Building Construction, NFPA No. 220–1969 for definitions of various types of construction. In congested areas such as offices, lunchrooms, locker rooms, time-clock areas.

(iii) *Handling of liquefied hydrogen inside buildings other than separate buildings and special rooms.* Portable liquefied hydrogen containers of 50 gallons or less capacity as permitted in Table H–3 and in compliance with subdivision (i)(f) of this subparagraph when housed inside buildings not located in a special room and exposed to other occupancies shall comply with the following minimum requirements:

(*a*) Be located 20 feet from flammable liquids and readily combustible materials such as excelsior or paper.

(*b*) Be located 25 feet from ordinary electrical equipment and other sources of ignition including process or analytical equipment.

(*c*) Be located 25 feet from concentrations of people.

(*d*) Be located 50 feet from intakes of ventilation and air-conditioning equipment or intakes of compressors.

(*e*) Be located 50 feet from storage of other flammable-gases or storage of oxidizing gases.

(*f*) Containers shall be protected against damage or injury due to falling objects or work activity in the area.

(*g*) Containers shall be firmly secured and stored in an upright position.

(*h*) Welding or cutting operations, and smoking shall be prohibited while hydrogen is in the room.

(*i*) The area shall be adequately ventilated. Safety relief devices on the containers shall be vented directly outdoors or to a suitable hood. See paragraphs (c)(1)(iv)(b) and (c)(2)(i)(f) of this section.

(3) *Design considerations at specific locations*—(i) *Outdoor locations.* (*a*) Outdoor location shall mean outside of any building or structure, and includes locations under a weather shelter or canopy provided such locations are not enclosed by more than two walls set at right angles and are provided with vent-space between the walls and vented roof or canopy.

(*b*) Roadways and yard surfaces located below liquefied hydrogen piping,

from which liquid air may drip, shall be constructed of noncombustible materials.

(*c*) If protective walls are provided, they shall be constructed of noncombustible materials and in accordance with the provisions of paragraph (c)(3)(i)(*a*) of this section.

(*d*) Electrical wiring and equipment shall comply with paragraph (c)(1)(ix)(*a*) and (*b*) of this section.

(*e*) Adequate lighting shall be provided for nighttime transfer operation.

(ii) *Separate buildings.* (*a*) Separate buildings shall be of light noncombustible construction on a substantial frame. Walls and roofs shall be lightly fastened and designed to relieve at a maximum internal pressure of 25 pounds per square foot. Windows shall be of shatterproof glass or plastic in metal frames. Doors shall be located in such a manner that they will be readily accessible to personnel in an emergency.

(*b*) Adequate ventilation to the outdoors shall be provided. Inlet openings shall be located near the floor level in exterior walls only. Outlet openings shall be located at the high point of the room in exterior walls or roof. Both the inlet and outlet vent openings shall have a minimum total area of 1 square foot per 1,000 cubic feet of room volume. Discharge from outlet openings shall be directed or conducted to a safe location.

(*c*) There shall be no sources of ignition.

(*d*) Electrical wiring and equipment shall comply with paragraphs (c)(1)(ix)(*a*) and (*b*) of this section except that the provisions of paragraph (c)(1)(ix)(*b*) of this section shall apply to all electrical wiring and equipment in the separate building.

(*e*) Heating, if provided, shall be by steam, hot water, or other indirect means.

(iii) *Special rooms.* (*a*) Floors, walls, and ceilings shall have a fire resistance rating of at least 2 hours. Walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall shall be an exterior wall. Openings to other parts of the building shall not be permitted. Windows and doors shall be in exterior walls and doors shall be located in such a manner that they will be accessible in an emergency. Windows shall be of shatterproof glass or plastic in metal frames.

(*b*) Ventilation shall be as provided in paragraph (c)(3)(ii)(*b*) of this section.

(*c*) Explosion venting shall be provided in exterior walls or roof only. The venting area shall be equal to not less than 1 square foot per 30 cubic feet of room volume and may consist of any one or any combination of the following: Walls of light noncombustible material; lightly fastened hatch covers; lightly fastened swinging doors opening outward in exterior walls; lightly fastened walls or roofs designed to relieve at a maximum pressure of 25 pounds per square foot.

(*d*) There shall be no sources of ignition.

(*e*) Electrical wiring and equipment shall comply with paragraph (c)(1)(ix)(*a*) and (*b*) of this section except that the provision of paragraph (c)(1)(ix)(*b*) of this section shall apply to all electrical wiring and equipment in the special room.

(*f*) Heating, if provided, shall be steam, hot water, or by other indirect means.

(4) *Operating instructions*—(i) *Written instructions.* For installation which require any operation of equipment by the user, legible instructions shall be maintained at operating locations.

(ii) *Attendant.* A qualified person shall be in attendance at all times while the mobile hydrogen supply unit is being unloaded.

(iii) *Security.* Each mobile liquefied hydrogen supply unit used as part of a hydrogen system shall be adequately secured to prevent movement.

(iv) *Grounding.* The mobile liquefied hydrogen supply unit shall be grounded for static electricity.

(5) *Maintenance.* The equipment and functioning of each charged liquefied hydrogen system shall be maintained in a safe operating condition in accordance with the requirements of this section. Weeds or similar combustibles

shall not be permitted within 25 feet of any liquefied hydrogen equipment.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49746, Oct. 24, 1978; 53 FR 12121, Apr. 12, 1988; 55 FR 32015, Aug. 6, 1990; 58 FR 35309, June 30, 1993; 61 FR 9236, 9237, Mar. 7, 1996; 69 FR 31881, June 8, 2004]

§ 1910.104 Oxygen.

(a) *Scope.* This section applies to the installation of bulk oxygen systems on industrial and institutional consumer premises. This section does not apply to oxygen manufacturing plants or other establishments operated by the oxygen supplier or his agent for the purpose of storing oxygen and refilling portable containers, trailers, mobile supply trucks, or tank cars, nor to systems having capacities less than those stated in paragraph (b)(1) of this section.

(b) *Bulk oxygen systems*—(1) *Definition.* As used in this section: A bulk oxygen system is an assembly of equipment, such as oxygen storage containers, pressure regulators, safety devices, vaporizers, manifolds, and interconnecting piping, which has storage capacity of more than 13,000 cubic feet of oxygen, Normal Temperature and Pressure (NTP), connected in service or ready for service, or more than 25,000 cubic feet of oxygen (NTP) including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers may be stationary or movable, and the oxygen may be stored as gas or liquid.

(2) *Location*—(i) *General.* Bulk oxygen storage systems shall be located above ground out of doors, or shall be installed in a building of noncombustible construction, adequately vented, and used for that purpose exclusively. The location selected shall be such that containers and associated equipment shall not be exposed by electric power lines, flammable or combustible liquid lines, or flammable gas lines.

(ii) *Accessibility.* The system shall be located so that it is readily accessible to mobile supply equipment at ground level and to authorized personnel.

(iii) *Leakage.* Where oxygen is stored as a liquid, noncombustible surfacing shall be provided in an area in which any leakage of liquid oxygen might fall during operation of the system and filling of a storage container. For purposes of this paragraph, asphaltic or bituminous paving is considered to be combustible.

(iv) *Elevation.* When locating bulk oxygen systems near above-ground flammable or combustible liquid storage which may be either indoors or outdoors, it is advisable to locate the system on ground higher than the flammable or combustible liquid storage.

(v) *Dikes.* Where it is necessary to locate a bulk oxygen system on ground lower than adjacent flammable or combustible liquid storage suitable means shall be taken (such as by diking, diversion curbs, or grading) with respect to the adjacent flammable or combustible liquid storage to prevent accumulation of liquids under the bulk oxygen system.

(3) *Distance between systems and exposures*—(i) *General.* The minimum distance from any bulk oxygen storage container to exposures, measured in the most direct line except as indicated in paragraphs (b)(3) (vi) and (viii) of this section, shall be as indicated in paragraphs (b)(3) (ii) to (xviii) of this section inclusive.

(ii) *Combustible structures.* Fifty feet from any combustible structures.

(iii) *Fire resistive structures.* Twenty-five feet from any structures with fire-resistive exterior walls or sprinklered buildings of other construction, but not less than one-half the height of adjacent side wall of the structure.

(iv) *Openings.* At least 10 feet from any opening in adjacent walls of fire resistive structures. Spacing from such structures shall be adequate to permit maintenance, but shall not be less than 1 foot.

(v) *Flammable liquid storage aboveground.*

Distance (feet)	Capacity (gallons)
50	0 to 1000.
90	1001 or more.

(vi) *Flammable liquid storage belowground.*

Distance measured horizontally from oxygen storage container to flammable liquid tank (feet)	Distance from oxygen storage container to filling and vent connections or openings to flammable liquid tank (feet)	Capacity gallons
15	50	0 to 1000.
30	50	1001 or more.

(vii) *Combustible liquid storage aboveground.*

Distance (feet)	Capacity (gallons)
25	0 to 1000.
50	1001 or more.

(viii) *Combustible liquid storage belowground.*

Distance measured horizontally from oxygen storage container to combustible liquid tank (feet)	Distance from oxygen storage container to filling and vent connections or openings to combustible liquid tank (feet)
15	40.

(ix) *Flammable gas storage.* (Such as compressed flammable gases, liquefied flammable gases and flammable gases in low pressure gas holders):

Distance (feet)	Capacity (cu. ft. NTP)
50	Less than 5000.
90	5000 or more.

(x) *Highly combustible materials.* Fifty feet from solid materials which burn rapidly, such as excelsior or paper.

(xi) *Slow-burning materials.* Twenty-five feet from solid materials which burn slowly, such as coal and heavy timber.

(xii) *Ventilation.* Seventy-five feet in one direction and 35 feet in approximately 90° direction from confining walls (not including firewalls less than 20 feet high) to provide adequate ventilation in courtyards and similar confining areas.

(xiii) *Congested areas.* Twenty-five feet from congested areas such as offices, lunchrooms, locker rooms, time clock areas, and similar locations where people may congregate.

(xiv)–(xvii) [Reserved]

(xviii) *Exceptions.* The distances in paragraphs (b)(3) (ii), (iii), (v) to (xi) inclusive, of this section do not apply where protective structures such as firewalls of adequate height to safeguard the oxygen storage systems are located between the bulk oxygen storage installation and the exposure. In such cases, the bulk oxygen storage installation may be a minimum distance of 1 foot from the firewall.

(4) *Storage containers*—(i) *Foundations and supports.* Permanently installed containers shall be provided with substantial noncombustible supports on firm noncombustible foundations.

(ii) *Construction—liquid.* Liquid oxygen storage containers shall be fabricated from materials meeting the impact test requirements of paragraph UG–84 of ASME Boiler and Pressure Vessel Code, Section VIII—Unfired Pressure Vessels—1968, which is incorporated by reference as specified in § 1910.6. Containers operating at pressures above 15 pounds per square inch gage (p.s.i.g.) shall be designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Section VII—Unfired Pressure Vessels—1968. Insulation surrounding the liquid oxygen container shall be noncombustible.

(iii) *Construction—gaseous.* High- pressure gaseous oxygen containers shall comply with one of the following:

(*a*) Designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Section VIII—Unfired Pressure Vessels—1968.

(*b*) Designed, constructed, tested, and maintained in accordance with DOT Specifications and Regulations.

(5) *Piping, tubing, and fittings*—(i) *Selection.* Piping, tubing, and fittings shall be suitable for oxygen service and for the pressures and temperatures involved.

(ii) *Specification.* Piping and tubing shall conform to Section 2—Gas and Air Piping Systems of Code for Pressure Piping, ANSI, B31.1–1967 with addenda B31.10a–1969, which is incorporated by reference as specified in § 1910.6.

(iii) *Fabrication.* Piping or tubing for operating temperatures below −20 °F. shall be fabricated from materials meeting the impact test requirements of paragraph UG–84 of ASME Boiler and Pressure Vessel Code, Section VIII—Unfired Pressure Vessels—1968, when tested at the minimum operating

temperature to which the piping may be subjected in service.

(6) *Safety relief devices*—(i) *General.* Bulk oxygen storage containers, regardless of design pressure shall be equipped with safety relief devices as required by the ASME code or the DOT specifications and regulations.

(ii) *DOT containers.* Bulk oxygen storage containers designed and constructed in accordance with DOT specification shall be equipped with safety relief devices as required thereby.

(iii) *ASME containers.* Bulk oxygen storage containers designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII—Unfired Pressure Vessel—1968 shall be equipped with safety relief devices meeting the provisions of the Compressed Gas Association Pamphlet ''Safety Relief Device Standards for Compressed Gas Storage Containers,'' S–1, Part 3, which is incorporated by reference as specified in § 1910.6.

(iv) *Insulation.* Insulation casings on liquid oxygen containers shall be equipped with suitable safety relief devices.

(v) *Reliability.* All safety relief devices shall be so designed or located that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device.

(7) *Liquid oxygen vaporizers*—(i) *Mounts and couplings.* The vaporizer shall be anchored and its connecting piping be sufficiently flexible to provide for the effect of expansion and contraction due to temperature changes.

(ii) *Relief devices.* The vaporizer and its piping shall be adequately protected on the oxygen and heating medium sections with safety relief devices.

(iii) *Heating.* Heat used in an oxygen vaporizer shall be indirectly supplied only through media such as steam, air, water, or water solutions which do not react with oxygen.

(iv) *Grounding.* If electric heaters are used to provide the primary source of heat, the vaporizing system shall be electrically grounded.

(8) *Equipment assembly and installation*—(i) *Cleaning.* Equipment making up a bulk oxygen system shall be cleaned in order to remove oil, grease or other readily oxidizable materials before placing the system in service.

(ii) *Joints.* Joints in piping and tubing may be made by welding or by use of flanged, threaded, slip, or compression fittings. Gaskets or thread sealants shall be suitable for oxygen service.

(iii) *Accessories.* Valves, gages, regulators, and other accessories shall be suitable for oxygen service.

(iv) *Installation.* Installation of bulk oxygen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use.

(v) *Testing.* After installation all field erected piping shall be tested and proved gas tight at maximum operating pressure. Any medium used for testing shall be oil free and nonflammable.

(vi) *Security.* Storage containers, piping, valves, regulating equipment, and other accessories shall be protected against physical damage and against tampering.

(vii) *Venting.* Any enclosure containing oxygen control or operating equipment shall be adequately vented.

(viii) *Placarding.* The bulk oxygen storage location shall be permanently placarded to indicate: ''OXYGEN—NO SMOKING—NO OPEN FLAMES'', or an equivalent warning.

(ix) *Electrical wiring.* Bulk oxygen installations are not hazardous locations as defined and covered in subpart S of this part. Therefore, general purpose or weatherproof types of electrical wiring and equipment are acceptable depending upon whether the installation is indoors or outdoors. Such equipment shall be installed in accordance with the applicable provisions of subpart S of this part.

(9) *Operating instructions.* For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations.

(10) *Maintenance.* The equipment and functioning of each charged bulk oxygen system shall be maintained in a safe operating condition in accordance with the requirements of this section. Wood and long dry grass shall be cut

back within 15 feet of any bulk oxygen storage container.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49746, Oct. 24, 1978; 61 FR 9237, Mar. 7, 1996]

§ 1910.105 Nitrous oxide.

The piped systems for the in-plant transfer and distribution of nitrous oxide shall be designed, installed, maintained, and operated in accordance with Compressed Gas Association Pamphlet G–8.1–1964, which is incorporated by reference as specified in § 1910.6.

[39 FR 23502, June 27, 1974, as amended at 61 FR 9237, Mar. 7, 1996]

§ 1910.106 Flammable and combustible liquids.

(a) *Definitions.* As used in this section:

(1) Aerosol shall mean a material which is dispensed from its container as a mist, spray, or foam by a propellant under pressure.

(2) Atmospheric tank shall mean a storage tank which has been designed to operate at pressures from atmospheric through 0.5 p.s.i.g.

(3) Automotive service station shall mean that portion of property where flammable or combustible liquids used as motor fuels are stored and dispensed from fixed equipment into the fuel tanks of motor vehicles and shall include any facilities available for the sale and service of tires, batteries, and accessories, and for minor automotive maintenance work. Major automotive repairs, painting, body and fender work are excluded.

(4) Basement shall mean a story of a building or structure having one-half or more of its height below ground level and to which access for fire fighting purposes is unduly restricted.

(5) Boiling point shall mean the boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (p.s.i.a.) (760 mm.). Where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, for purposes of this section the 10 percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D–86–62, which is incorporated by reference as specified in § 1910.6, may be used as the boiling point of the liquid.

(6) Boilover shall mean the expulsion of crude oil (or certain other liquids) from a burning tank. The light fractions of the crude oil burnoff producing a heat wave in the residue, which on reaching a water strata may result in the expulsion of a portion of the contents of the tank in the form of froth.

(7) Bulk plant shall mean that portion of a property where flammable or combustible liquids are received by tank vessel, pipelines, tank car, or tank vehicle, and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, or container.

(8) Chemical plant shall mean a large integrated plant or that portion of such a plant other than a refinery or distillery where flammable or combustible liquids are produced by chemical reactions or used in chemical reactions.

(9) Closed container shall mean a container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.

(10) Crude petroleum shall mean hydrocarbon mixtures that have a flash point below 150 °F. and which have not been processed in a refinery.

(11) Distillery shall mean a plant or that portion of a plant where flammable or combustible liquids produced by fermentation are concentrated, and where the concentrated products may also be mixed, stored, or packaged.

(12) Fire area shall mean an area of a building separated from the remainder of the building by construction having a fire resistance of at least 1 hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1 hour.

(13) Flammable aerosol shall mean an aerosol which is required to be labeled ''Flammable'' under the Federal Hazardous Substances Labeling Act (15 U.S.C. 1261). For the purposes of paragraph (d) of this section, such aerosols are considered Class IA liquids.

(14) *Flashpoint* means the minimum temperature at which a liquid gives off vapor within a test vessel in sufficient

Appendix C

FORM TO REQUEST PRIOR APPROVAL

FORM TO REQUEST PRIOR APPROVAL

Date:

Location where experiment/procedure will take place

Building:
Department:
Room Number:
Person Seeking Approval:
Contact Phone Number:
Email Address:

EXPERIMENT, CHEMICAL ACQUISITION OR PROCEDURE REQUIRING PRIOR APPROVAL:

Prior approval is required before doing any procedure and/or prior to acquiring any chemical(s) that could result in one or more of the following conditions (check all that apply):

- ☐ Potential for a rapid rise in temperature.
- ☐ Potential for a rapid increase in pressure.
- ☐ Potential for chemical explosion.
- ☐ Potential for spontaneous combustion.
- ☐ Potential for the emission of toxic gases that could produce concentrations in the air that exceed toxic limits.

Prior approval should also be obtained before again performing any procedure after there has been an incident or exposure as a result of the failure of any of the equipment or systems needed for the safe process, handling, storage and use of the material (i.e. fume hood failure, fire, explosion or any other unsafe condition directly related to the material identified herein).

Detailed Explanation of Procedure/Reason for Prior Approval Request (add add'l page(s), as necessary):

☐ APPROVED

☐ DISAPPROVED (if so, CHO shall provide a written explanation)

SIGNATURE:_____ DATE:_____

Chemical Hygiene Officer

Appendix D

HAZARDOUS CHEMICAL EXPOSURE INCIDENT REPORT FORM

Farmingdale State College
State University of New York

Hazardous Chemical Exposure Incident Report

INSTRUCTIONS: Use the forms in this package to document routes and circumstances of a hazardous chemical exposure incident.

Hazardous Chemical Exposure Incident Report		
NAME OF FORM	**PAGE**	**ACTION**
Part 1	1 – 2	1. Completed by employee 2. Employee receives a copy 3. Human Resources receives a copy
Part 2	3	1. Completed by Environmental Health and Safety Officer 2. Employee receives a copy 3. Human Resources receives a copy
Part 3	4	1. Completed by Exposed Employee's Medical Care Provider 2. Medical Care Provider mails direct to Human Resources 3. Medical Care Provider mails direct to Environmental Health and Safety Officer
Part 3A	6	1. Completed by the Exposed Employee to record Medical Evaluation follow up 2. Employee mails direct to Human Resources 3. Employee mails direct to Environmental Health and Safety Officer
Part 3B	7	1. Completed by the Exposed Employee's Medical Care Provider to record Medical Evaluation Follow-up 2. Medical Care Provider mails direct to Human Resources 3. Medical Care Provider mails direct to Environmental Health and Safety Officer

Hazardous Chemical Exposure Incident Report

Part 1 (to be completed by Employee)

Please print or type all information

DEMOGRAPHICS		
Date (of form completion):	Department:	Work Telephone:
Employee's Last Name:	Employee's First Name:	
Date of Birth:	Social Security #:	
Home Telephone #:	Other Contact # (i.e. mobile):	

EXPOSURE INCIDENT	
Date of Exposure:	Time of Exposure (be sure to note a.m. or p.m.):
Where Did the Incident Take Place (be as specific as possible)?	
Nature of the Incident (i.e. injured body part, difficulty breathing, chemical burn, etc.)?	
What Tasks Were You Performing When the Exposure Took Place (please indicate if task(s) were routine or if they varied from your regular work duties). If varied, please explain why you were engaging in said activity(ies) [include additional page(s), as necessary]?	

List chemical(s), amount and concentration in use at time of exposure [include additional page(s), as necessary]:

Chemical Name	Amt.	Conc.	Chemical Name	Amt.	Conc.
1.			2.		
3.			4.		

CONTROLS MEASURES
Provide details about any control measures in use at the time of exposure (i.e. Fume Hood, Dust Mask, etc.):

PERSONAL PROTECTIVE EQUIPMENT - PPE	
Were you wearing any Personal Protective Equipment (PPE) [i.e. safety glasses, lab coat, ear muffs, nitrile gloves, etc.)?: ☐ YES ☐ NO	If **YES**, Describe what type:
Did the PPE Fail? ☐ YES ☐ NO	If **YES**, Describe how (provide additional detail below, as needed):
Additional detail:	

INCIDENT EXPOSURE	
What Part(s) of your Body was Exposed?	Estimate the Size or Area of your Body that was Exposed:
How Long Did The Exposure Last (# of seconds, min., hours, etc.)?	
Is a Safety Data Sheet (SDS) attached to this Report? ☐ YES ☐ NO	

SIGNS AND SYMPTOMS	
Did you develop or experience any signs or symptoms as a result of the exposure? ☐ YES ☐ NO	
If yes, list them below (i.e. headache, nausea, rash, etc.):	
1.	2.
3.	4.
5.	6.
Are signs and symptoms currently present (at time of form completion)? ☐ YES ☐ NO	
Are the signs and symptoms those documented on the SDS? ☐ YES ☐ NO ☐ N/A	
Is Exposure monitoring data available? ☐ YES ☐ NO ☐ N/A	

Employee Signature _____ Supervisor's Signature _____

Date _____ Date _____

As stipulated and in accordance with 29 CFR 1910.20, the Occupational Exposure to Hazardous Chemicals in Laboratories standard 29 CFR 1910.1450, form and related documentation will be kept on file by Farmingdale State College for the length of employment and 30 years thereafter. This form and related documentation will remain confidential. Personal identifying information will be released with your consent only.

Hazardous Chemical Exposure Incident Report

Part 2 (to be completed by Environmental Health and Safety Officer)

Please print or type all information

DEMOGRAPHICS		
Date (of form completion):	Name of EH&S Officer Completing Form:	EH&S Officer Work Telephone:
Employee's Last Name:	Employee's First Name:	
Employee Date of Birth:	Employee Social Security #:	
Employee Home Telephone #:	Employee Other Contact # (i.e. mobile):	
Is a Comprehensive Accident Report Detailing This Incident On file? ☐ YES ☐ NO		
Is a SH 900 and Related Documents Detailing this Incident On File? ☐ YES ☐ NO ☐ N/A		
EH&S Officer Comment:		

EH&S OFFICER TO SUBMIT COMPLETED COPIES OF FORMS PART 1 AND 2 TO:	
[enter exposed employee's name and address]	Farmingdale State College ATTN: Marybeth Incandela Director of Human Resources Whitman Hall 2350 Broadhollow Road Farmingdale, NY 11735 ph. (934) 420-2107 fax (934) 420-2489 incandm@farmingdale.edu

Environmental Health and Safety Officer's Signature

Supervisor's Signature

Date

Date

As stipulated and in accordance with 29 CFR 1910.20, the Occupational Exposure to Hazardous Chemicals in Laboratories standard 29 CFR 1910.1450, form and related documentation will be kept on file by Farmingdale State College for the length of employment and 30 years thereafter. This form and related documentation will remain confidential. Personal identifying information will be released with your consent only.

Hazardous Chemical Exposure Incident Report

Part 3 (to be completed by Exposed Employee's Medical Care Provider)

Please print or type all information

EXPOSED EMPLOYEE	
Employee's Last Name:	Employee's First Name:
Date of Birth:	Social Security #:
Work Site Name:	Work Telephone:
MEDICAL CARE PROVIDER	
Health Care Professional Name:	Title:
Office Location (Street and Number, City, State, Zip):	
Office Telephone:	Office Fax Number:
MEDICAL CARE PROVIDER'S REPORT	
Did You Treat The Patient/Employee Directly? ☐ YES ☐ NO	
If **YES**, Specify Treatment Regimen [include additional page(s), as necessary]:	
Other Pertinent Information [include additional page(s), as necessary]:	

Medical Care Provider's Signature _____ Date _____

As stipulated and in accordance with 29 CFR 1910.20, the Occupational Exposure to Hazardous Chemicals in Laboratories standard 29 CFR 1910.1450, form and related documentation will be kept on file by Farmingdale State College for the length of employment and 30 years thereafter. This form and related documentation will remain confidential. Personal identifying information will be released with your consent only.

MEDICAL CARE PROVIDER TO SUBMIT COMPLETED COPY OF FORM PART 3 TO:	
Farmingdale State College ATTN: Marybeth Incandela Director of Human Resources Whitman Hall 2350 Broadhollow Road Farmingdale, NY 11735 ph. (934) 420-2107 fax (934) 420-2489 incandm@farmingdale.edu	Farmingdale State College ATTN: Jeff Carter, CHMM, CHO, MPS Environmental Health and Safety Officer Horton Hall 2350 Broadhollow Road Farmingdale, NY 11735 ph. (934) 420-2105 fax (934) 420-9173 carterj@farmingdale.edu

Hazardous Chemical Exposure Incident Report

Part 3A (to be completed by Exposed Employee to record Medical Evaluation follow up)

Please print or type all information

EXPOSED EMPLOYEE		
Date (of form completion):	Department:	Work Telephone:
Employee's Last Name:	Employee's First Name:	Social Security #:

Job Title at Time of Exposure:	Date and Time of Exposure:
Date of Follow Up:	Name and Location of Medical Treatment Facility:
Reason for Follow Up:	

EMPLOYEE TO SUBMIT COMPLETED COPY OF FORM PART 3A TO:	
Farmingdale State College ATTN: Marybeth Incandela Director of Human Resources Whitman Hall 2350 Broadhollow Road Farmingdale, NY 11735 ph. (934) 420-2107 fax (934) 420-2489 incandm@farmingdale.edu	Farmingdale State College ATTN: Jeff Carter, CHMM, CHO, MPS Environmental Health and Safety Officer Horton Hall 2350 Broadhollow Road Farmingdale, NY 11735 ph. (934) 420-2105 fax (934) 420-9173 carterj@farmingdale.edu
Supervisor's Statement/Comments (enter "N/A" if no additional information/detail warranted):	

Employee Signature _____ Supervisor's Signature _____

Date _____ Date _____

As stipulated and in accordance with 29 CFR 1910.20, the Occupational Exposure to Hazardous Chemicals in Laboratories standard 29 CFR 1910.1450, form and related documentation will be kept on file by Farmingdale State College for the length of employment and 30 years thereafter. This form and related documentation will remain confidential. Personal identifying information will be released with your consent only.

Hazardous Chemical Exposure Incident Report

Part 3B (to be completed by the Exposed Employee's Medical Care Provider to record Medical Evaluation follow up)

Please print or type all information

MEDICAL CARE PROVIDER	
Health Care Professional Name:	Title:
Office Location (Street and Number, City, State, Zip):	
Office Telephone:	Office Fax Number:
MEDICAL CARE PROVIDER'S REPORT	
Employee Health File Reviewed? ☐ YES ☐ NO	Date of Review:
Medical Care Provider's Findings & Observations:	
Is Additional Follow Up Needed (if so, explain why):	
Other Pertinent Information:	

MEDICAL CARE PROVIDER TO SUBMIT COMPLETED COPY OF FORM PART 3B TO:	
Farmingdale State College ATTN: Marybeth Incandela Director of Human Resources Whitman Hall 2350 Broadhollow Road Farmingdale, NY 11735 ph. (934) 420-2107 fax (934) 420-2489 incandm@farmingdale.edu	Farmingdale State College ATTN: Jeff Carter, CHMM, MPS Environmental Health and Safety Officer Horton Hall/Administration and Finance 2350 Broadhollow Road Farmingdale, NY 11735 ph. (934) 420-2105 fax (934) 420-9173 carterj@farmingdale.edu

Medical Care Provider's Signature _____ Date _____

As stipulated and in accordance with 29 CFR 1910.20, the Occupational Exposure to Hazardous Chemicals in Laboratories standard 29 CFR 1910.1450, form and related documentation will be kept on file by Farmingdale State College for the length of employment and 30 years thereafter. This form and related documentation will remain confidential. Personal identifying information will be released with your consent only.

Appendix E

LABORATORY SAFETY EQUIPMENT

LABORATORY SAFETY EQUIPMENT
(for reference purposes only)

Personal Clothing and Equipment

Aprons, rubber or plastic	Extends to or below the knees.
Gloves	The material from which the glove is made must be carefully chosen so that the glove is not permeable to the liquids or vapors anticipated for the experiment.
Chemical splash goggles	Meets ANSI Standard Z87.1 for chemical splash-proof goggles. Indirect ventilation. NOT the same as most goggles sold in hardware stores!
Face shield	When used, should be worn with goggles.
Laboratory Coat, Tyvek, Dacron & cotton, cotton	Has long sleeves. Has Velcro or snap fasteners. Extends to or below the knees.
Self-contained breathing apparatus	Use restricted to professionals who have been properly trained and have maintained certification.

Laboratory Safety Equipment

Drench shower	Ceiling and wall-mounted showers should operate by chain pull valve. Should deliver tepid, potable water for at least 15 minutes without need to hold valve.
Eye wash fountain	Should deliver tepid, potable water to both eyes. Should provide a steady, gentle flow for at least 15 minutes without need to hold valve.
Fire blanket, wool	Most useful to keep a victim warm while waiting for medical attention. A blanket should be available but not on a roller. The purpose of the blanket is to cover the victim, Not encircle. Wrapping a burning victim may cause additional burns to neck and face due to the chimney effect.
Fire extinguisher	Should be suitable for Class A, B & C fires.
First aid kit	Any good, general purpose first aid kit is suitable.
Flammable storage cabinet	May be made of wood or metal. Should be vented directly to the outside.

	Check local fire codes.
Fume Hood	Should have a face velocity of 60–100 linear feet per minute. Should be vented to the outside. May have a vertical or horizontal sash. Should be kept clean and uncluttered.
Safety cans	Some occasions demand that volatile, flammable or combustible solvents be stored in safety cans. Each can should have a flame arrestor in good working order. Check local fire codes and NFPA standards 30 and 45.
Signs	Signs are useful for designating the location of safety equipment, means of ingress and egress, etc. Signs should be chosen to be in conformity with state guidelines and recommendations.
Smoke alarm	Check local fire codes.

<u>Laboratory Spill Protection</u>

General purpose	A general purpose adsorbent, such as a mixture of kitty litter, sand, and vermiculite is suitable for containing many chemical spills.
Acid spills	Best treated with sodium bicarbonate, which may be mixed with kitty litter and/or sand.
Base spills	Best treated with sodium bisulfate, which may be mixed with kitty litter and/or sand.
Halogen spills	Best treated with sodium thiosulfate, which may be mixed with kitty litter and/or sand.

Appendix F

LABORATORY SAFETY INSPECTION FORM

Building: _____ Room #: _____ Inspector: _____ Date: ____/____/_____

Q #	Laboratory Safety Inspection Form	No Deficiency Observed	Deficiency	Not Inspected	N/A
General Safety					
1	Lab is maintained secure; door is locked when no one is in lab.				
2	Appropriate clothing (no shorts or sandals) worn by everyone in lab.				
3	Personal protective equipment (PPE) (i.e. lab coats, nitrile gloves, safety glasses, etc.) is available in labs handling chemicals, infectious materials, or any other health/physical hazard.				
4	Work and storage areas clear of clutter; access to exit is unrestricted.				
5	No food or drinks found in labs.				
6	Emergency phone numbers & plan posted next to phone.				
7	Eyewash not blocked; can be accessed easily.				
8	Fume hood free of clutter and stored chemicals.				
9	No visible mold growth evident (i.e. ceiling tiles with dark/black mold, mold patches on walls, etc.).				
Chemical Safety					
10	Appropriate labels are found on all hazardous chemical containers.				
11	Flammable liquid storage is limited to 25 gallons/room w/o flammable cabinet.				
12	No flammable chemicals stored in regular refrigerator.				
13	All compressed gas cylinders secured in upright position.				
14	All compressed gas cylinders capped when not in use.				
15	Shelves and chemical containers in good condition (no leaks, rust).				
16	Spill control equipment (neutralizers, absorbent pads) are present.				
17	Incompatible materials are stored separately from one another.				
Hazardous Waste					
18	Satellite Accumulation Area (SAA) is located at or near where hazardous waste is generated.				
19	Maximum SAA storage capacity not exceeded (55-gallons per hazardous waste stream).				
20	Hazardous waste containers are in good condition (not leaking, rusted, bulging or damaged).				
21	Each hazardous waste container is marked with the words “Hazardous Waste”.				
22	Each hazardous waste container is marked with full chemical names identifying the contents stored inside (no abbreviations or formulas).				
23	Hazardous waste containers are kept closed unless adding waste.				
24	Waste containers storing liquid hazardous waste at or near sinks and drains are stored within secondary containment.				
25	Secondary containment is in good condition (free of cracks, gaps and impervious to leaks).				
26	Incompatible hazardous wastes are stored separately from one another.				
Biological Safety					
27	Sharps are disposed in a proper container that is kept closed unless waste is being added.				
28	Regulated medical waste is placed in red bags within boxes that are properly labeled or in another suitable container (e.g. 55-gallon fiberboard drum).				
29	Biological materials are not stored in hallways or chaseways in unlocked freezers or refrigerators.				
30	Disinfectants are on hand for sanitizing bench tops and treating spills.				
31	Biohazard signs are posted in labs handling infectious materials (BSL2 >).				
32	Lab coats, gowns or scrubs are in use in labs handling infectious materials (BSL2 >).				
33	Biological safety cabinet(s) (in labs BSL2>) were certified within the last 12 months.				
Radiation Safety					
34	If radioactive material is present, a proper sign is posted on the lab door.				
35	Radioactive and/or mixed waste containers are properly labeled.				
36	The GM meter(s) is calibrated at least once per year.				
37	The radioactive material use area is marked properly.				
38	The radioactive material storage freezer is properly labeled.				
39	Vials of radioactive material within a freezer are stored in a proper "lock box".				
Comments:					

Q #	Laboratory Safety Inspection Form Responses
1	The laboratory door must be closed and locked when no one is in the lab. Hazardous chemicals/biological material/radioactive material must be kept secured from unauthorized access.
2	Legs and feet must be covered when working in a lab. No shorts or sandals are permitted in a lab.
3	Depending on the specific hazard analysis for said lab (which is the responsibility of the Dept. Head or Principal Investigator), proper personal protective equipment must be used whenever there is a risk of exposure and when engineering controls are not a viable option.
4	The aisles must be clear for walking to the emergency eyewash and exit door in case of an emergency. The laboratory floor should not be used to store boxes and chemical containers.
5	Food and drink are strictly prohibited in laboratories, including desks in labs and areas where hazardous chemicals, biological materials and/or radioactive materials are stored and used.
6	Post the University Police phone number, the name and 24 hour contact information for the responsible person(s) (i.e. Principal Investigator), and the lab emergency plan near the phone or by the door (or both!).
7	Do not block the emergency eyewash with lab equipment. Lab workers should be able to find the eyewash with their eyes closed.
8	Fume hoods are not to be used to store chemicals. They are designed to be used to protect lab workers handling hazardous materials. Storage and clutter will interfere with proper air flow.
9	Indoor mold growth can and should be prevented or controlled by maintaining proper moisture (humidity) levels indoors. If there is mold growth, it must be cleaned up and the water problem fixed.
10	Chemical containers must be identified with the product name and the appropriate hazard warning. Containers that come from the manufacturer (primary container) are labeled by the manufacturer. Any secondary container (rinse bottles, etc) that will not be under the control of the lab worker at all times must be labeled by the lab worker.
11	The total amount of flammable liquids (new, in use and waste) on bench tops and open shelves cannot exceed 25 gallons. If additional flammable liquids must be kept in the room, an approved flammable storage cabinet must be used.
12	Flammable chemicals can not be safely stored in domestic refrigerators. Flammable chemicals that need to be refrigerated must be stored in a laboratory safe refrigerator.
13	Cylinders must be transported, stored and used upright (with the valve up), and must be securely fastened to prevent them from falling or being knocked over. Suitable racks, straps, chains or stands are required to support cylinders.
14	Cylinder valves are to be protected with the protective cap when not in use (empty or full). "In Use" means that the cylinder and regulator are attached to another piece of equipment or the gas is in use during that work day.
15	Shelves and containers must be inspected weekly to confirm that no containers are leaking, bulging or have labels falling off and that the shelves are not rusted or have spilled materials on them.
16	Spill control equipment must be readily available to quickly respond to minor releases of the types of chemicals used and hazardous waste generated in your laboratory. It is the responsibility of each laboratory to purchase their own spill kits.
17	Incompatible materials (i.e. acids and bases, oxidizers and organics) must be separated by either secondary containment or by distance (preferred).
18	Satellite Accumulation Area (SAA) must be under the control of the individual directly responsible for the process that generates the waste. SAA must be at or near each specific point of generation where wastes initially accumulate.

Q #	Laboratory Safety Inspection Form Responses
19	Maximum capacity of containers stored at each SAA is 55 gallons of hazardous waste and/or one quart of acutely hazardous waste. When the amount of hazardous waste exceeds 55 gallons or the amount of acutely hazardous waste exceeds one quart, the excess waste shall be dated immediately and within 3 days, moved to the main storage area and come into compliance with all regulations pertaining to that area. To arrange for a hazardous waste pickup for waste that has exceeded its storage capacity, submit a Work Order or call 934-420-2105 for further instruction.
20	Containers must be in good condition (free of rust and/or structural damage).
21	Each container shall be marked with the words "Hazardous Waste".
22	Each container shall be marked with the full chemical names of all hazardous constituents (e.g., acetone, toluene); do not use abbreviations or formulas.
23	All hazardous waste storage containers must be kept closed unless adding or removing waste.
24	Secondary containment capable of containing 10% of the total volume of all waste containers being stored or 110% of the largest container must be used for all liquid hazardous waste containers stored at or near a drain. Secondary containment bins can be obtained by calling the EH&S Officer at 934-420-2105
25	Secondary containment capable of containing 10% of the total volume of all liquid waste containers being stored or 110% of the largest liquid container must be in good condition (free of cracks, gaps and impervious to leaks). Secondary containment bins can be obtained by calling the EH&S Officer at 934-420-2105.
26	Incompatible hazardous wastes (i.e. acids and bases, oxidizers and organics) must be separated by either secondary containment or by distance (preferred).
27	All sharps waste must be disposed of in a properly labeled, puncture-resistant container that is kept closed when not in use.
28	All RMW must be disposed of by using a red RMW bag and stored within a properly labeled outer cardboard box or in another ***approved*** , alternative container (i.e. 55-gallon fiberboard drum).
29	All biological materials must be stored in a secure location to ensure that they are safe from inadvertent exposures and misuse by unauthorized users.
30	All labs working with biological materials must disinfect benchtops daily and after any spills with a disinfectant effective for the biological agents in use.
31	All labs using or storing infectious agents must post a biohazard sign that appropriately identifies the hazard(s).
32	All personnel working at BSL2 or above must wear protective clothing (lab coats, gowns, or scrubs) when working with biohazardous materials.
33	Biological Safety Cabinets require annual certification to ensure that they will contain biohazardous materials and adequately protect lab personnel.
34	All rooms authorized for use with radioactive materials must have a "Caution Radioactive Materials" sign posted on the exterior door.
35	All containers used to dispose of radioactive waste must have a radioactive inventory log sheet and a "caution radioactive materials" sticker on the exterior of the container.
36	All instruments used in the laboratory to detect and monitor radioactivity must be calibrated at least once per year.
37	All areas in the laboratory that are used for research with radioactive materials must be clearly delineated from nonradioactive material use areas.
38	The freezer, refrigerator, cabinet used to store vials of radioactive materials must be posted with a "Caution Radioactive Materials" sticker.
39	Vials containing radioactive material within a freezer must be secured inside a "lock box" .

Appendix G

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Appendix H

RECORD OF TRAINING

RECORD OF TRAINING

Employee Name:
SS Number or RAM ID:
Job Assignment:
Job Location:

The above-named employee has received training, as specified in the applicable Chemical Hygiene Plan, in the following areas (check all that apply):

- ☐ Federal & state chemical hygiene standards
- ☐ Location and content of the Chemical Hygiene Plan
- ☐ Hazards of chemicals in the workplace
- ☐ Proper procedures for requesting authorization to obtain and use chemicals considered too hazardous for general school laboratories
- ☐ Labeling and storage practices, and information to interpret labels
- ☐ Location and content of SDSs
- ☐ Location of safety references
- ☐ Location and proper use of protective apparel & equipment
- ☐ Appropriate first aid techniques
- ☐ Procedures for responding to chemical exposures
- ☐ Procedures for reporting accidents
- ☐ Methods to detect presence or release of hazardous chemicals used in the laboratory
- ☐ Proper operation of fire extinguisher

Trainer: _____ _____ _____
Printed Name Signature Date

Employee: _____ _____ _____
Printed Name Signature Date

Submit this original, signed Record of Training to the Chemical Hygiene Officer at Horton Hall and maintain a copy for your records.

Chemical Hygiene Officer Date of Receipt: _____

Chemical Hygiene Officer: _____ _____
Printed Name Signature